ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

DATE

February 1999

BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102A Defense Research Sciences

1 - Dasic Nesearch			000	JIIUZA L	Jelelise i	vesear cri	Science	3		
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	120211	125314	125613	128578	131489	148438	157541	163700	Continuing	Continuing
AF20 Advanced Propulsion Research	2282	2068	2426	2504	2608	3006	3235	3378	Continuing	Continuing
AF22 Research in Vehicular Mobility	446	469	474	486	495	605	666	689	Continuing	Continuing
AH42 Materials and Mechanics	1817	1647	1919	1987	2045	2377	2520	2625	Continuing	Continuing
AH43 Research in Ballistics	5407	3150	4025	4131	4240	4480	4783	4962	Continuing	Continuing
AH44 Advanced Sensors Research	3834	4410	4062	4156	4250	4515	4796	4957	Continuing	Continuing
AH45 Air Mobility	1836	1880	1991	2044	2102	2528	2807	2913	Continuing	Continuing
AH47 Applied Physics Research	2910	2643	3080	3177	3275	3734	4099	4269	Continuing	Continuing
AH48 Battlespace Information & Communications Res	6709	5614	6762	6940	7126	7568	8039	8523	Continuing	Continuing
AH52 Equipment for the Soldier	857	866	944	981	1015	1222	1306	1364	Continuing	Continuing
BH57 Scientific Problems with Military Applications	48713	52727	50713	51786	52798	58179	59685	61620	Continuing	Continuing
AH66 Advanced Structures Research	1320	1207	1411	1459	1508	1607	1875	1958	Continuing	Continuing
BH67 Environmental Research - Army Material Cmd	3305	3235	3529	3586	3653	4069	4163	4363	Continuing	Continuing
AH68 Processes in Pollution Abatement Technology	316	370	370	377	382	451	459	478	Continuing	Continuing
BS04 Military Pollutants and Health Hazards	535	572	625	635	645	757	776	800	Continuing	Continuing
BS13 Science Base/Medical Research infectious Disease	8341	9090	8997	9206	9425	11890	12642	13373	Continuing	Continuing
BS14 Science Base/Combat Casualty Care Research	3704	3664	3972	4056	4143	4701	5360	5640	Continuing	Continuing
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Exhibit R-2 (PE 0601102A)

								DATE Fe l	bruary 19	99
BUDGET ACTIVITY 1 - Basic Research				JMBER AND 1102A	TITLE Defense I	S				
BS15 Science Base/Army Operational Medicine Research	4990	9341	5378	5508	5640	7351	8286	8572	Continuing	Continuin
BS17 Molecular Biology/Military HIV Research	412	397	435	441	448	485	648	667	Continuing	Continuin
BS19 Telemedicine Soldier Status Research	0	465	615	624	635	614	677	709	Continuing	Continuin
AT22 Soil and Rock Mechanics	1798	1802	1869	1898	1929	2197	2546	2619	Continuing	Continuin
AT23 Basic Research/Military Construction	1427	1564	1579	1605	1630	1907	2209	2271	Continuing	Continuin
AT24 Snow, Ice and Frozen Soil	1357	1157	1166	1184	1204	1410	1627	1673	Continuing	Continuin
BT25 Environmental Research - Corps of Engineers	4209	4135	4458	4530	4601	5042	5134	5343	Continuing	Continuin
A305 Automatic Target Recognition Research	1110	1019	1174	1207	1239	1377	1528	1585	Continuing	Continuin
A31B Infrared Optics Research	2202	1998	2341	2421	2504	2893	3121	3259	Continuing	Continuin
B52C Mapping and Remote Sensing	2026	2284	2305	2342	2379	2785	3236	3328	Continuing	Continuin
B53A Battlefield Environment and Signature	3470	3146	3678	3804	3942	4614	4928	5143	Continuing	Continuin
B74A Human Engineering	2453	2248	2607	2685	2766	3175	3446	3586	Continuing	Continuin
B74F Personnel Performance and Training	2425	2146	2708	2818	2862	2899	2944	3033	Continuing	Continuin

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit) BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences

A. Mission Description and Justification: This program element is focused on sustaining the Army's technological superiority for effectiveness in land warfighting capability and the Army Vision for Force XXI and the Army After Next (AAN). The program focuses in-house laboratory research on Army unique expertise and capabilities, capitalizing on the scientific talent and specialized facilities to expeditiously transition the resulting knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry for those areas where the Army does not have the technical lead. This translates to a coherent, well-integrated program which is executed by the following six primary contributors: 1) the Army Research Laboratory (ARL); 2) the seven Army Materiel Command Research, Development and Engineering Centers (RDECs); 3) the four Army Corps of Engineer laboratories; 4) the six Army Medical Research and Materiel Command laboratories; 5) the Army Research Institute; and 6) the Army Research Office (ARO). The Army's research program promotes quality through activities such as in-depth reviews of the entire basic research program at all levels and the development of strategic research objectives. The Army broadened its research base by expanding basic research investment in Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs) to 5% of its individual investigator program. This core research program is complemented by the inter-disciplinary research performed under the University Research Institutive (URI) program. The basic research program is coordinated with the other Services via the Joint Directors of Laboratories panels, Project Reliance, and other interservice working groups. The work in this program element is consistent with rigorous peer review, the Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) milestones for the Army's key emerging technol

Work in this program element is related to and fully coordinated with efforts in PE 0601104A (University/Industry Research Centers), PE 0602120A (Electronic Survivability and Fusing Technology), PE 0602618A (Ballistics Technology), PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology), PE 0602720A (Environmental Quality Technology), PE 0602784A (Military Engineering Technology), PE 0602786A (Logistics Technology), PE 0602787A (Medical Technology), PE 0603105A (Medical Human Immunodeficiency Virus (HIV) Research), PE 0603002A (Medical Advanced Technology), PE 0603807A (Medical Systems-Advanced Development), PE 0604807A (Medical Materiel/Medical Defense Equipment-Engineering Development), PE 0605801A (Program wide Activities, Project MMO2), PE 0605898A (Management Headquarters R & D, Project MMO3), and PE 0601103D (University Research Initiatives); the Navy, Air Force, and other Department of Defense agencies; National Aeronautics and Space Administration; National Science Foundation; Department of the Interior; Department of Energy; National Bureau of Standards; other government agencies; and government agencies of Allied nations sponsor related research in areas of this program.

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

DATE

February 1999

BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102A Defense Research Sciences

B. Program Change Summary	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (<u>FY 1999</u> PB)	121827	137399	144863	148336
Appropriated Value	125798	126463		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-3971	-1149		
b. SBIR / STTR	-2338	-3079		
c. Omnibus or Other Above Threshold Reductions	-773			
d. DoD Internal Reprogramming	+1500			
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB		·	-19096	-20293
Current Budget Submit (FY 2000 / 2001 PB)	120216	122235	125767	128043

Change Summary Explanation: Funding – execution.

FY 1998 DoD Internal Reprogramming (+1500) realigned funds from Defense health Programs for proper program

FY 1999 Congressional reduction to President's Budget request (-10936).

FY 2000 reduction (-19096) due to rebaselining of Army Basic Research Program and return of HBCU/MI Program to OSD.

FY 2001 reduction (-20293) due to rebaselining of Army Basic Research Program and return of HBCU/MI Program to OSD.

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Exhibit R-2 (PE 0601102A)

ARMY RDT&E BUD	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)										
BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences								es	PROJECT AF20		
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	-	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost	
AF20 Advanced Propulsion Research	2282	2068	24	126 250	2608	3006	3235	3378	Continuing	Continuing	

Mission Description and Justification: This project is a joint Army/NASA effort and it is the only DoD basic research project focused on turboshaft engine-specific technology and mechanical power transmission technology. The Army is the lead service in these technology areas (under Project Reliance) and performs basic research in propulsion, as applicable to rotorcraft and tracked and wheeled vehicles. Analysis, code development, experiments and evaluations are conducted to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. The goal of the activity is increased performance of small airbreathing engines and power trains that will support improvements in system mobility, reliability and survivability, and ultimately serve to reduce the logistics cost burden. Logistic issues are key concerns in the Army After Next planning.

FY 1998 Accomplishments:

- 2282 Completed 3-D particle image velocimetry mapping of compressor/diffuser flow field to provide fundamental information essential for advanced high performance centrifugal compressor design.
 - Completed Version 1.0 (unstructured grid version) of the National Combustor Code and release to US industry for the design of next generation gas turbine combustors.
 - Obtained fundamental heat transfer data for developing/validating wall function models for 3-D Navier Stokes internal/external cooling flow and heat transfer calculations. The new insights into the coupling of internal cooling and film cooling heat transfer will enable high performance turbine designs with less reliance on parasitic cooling flow.
 - Completed installation of a high-speed helical gearing loss-of-lube rig. This rig will enable improvements to rotorcraft transmission safety while reducing lubrication system weight.
 - Completed characterization of oxidation resistant coatings for monolithic silicon carbide and large fiber diameter reinforced composite. These coatings are mandatory for successful implementation of ceramic matrix composites (CMCs) in high temperature gas turbines.
 - Developed preliminary life prediction methodology for advanced CMC material that addresses the major thermomechanical issues concerning their introduction into manned gas turbine engines.
 - Developed and validated a diesel piston thermal barrier coating (TBC) low cycle fatigue/ high cycle fatigue facility and methodology to duplicate engine failure conditions and evaluate new coatings. The facility will screen candidate TBCs for use on test specimens (pistons) that will be tested by the Army Tank and Automotive Command.
 - Developed comprehensive analytical model of planetary gearset dynamics. Model has yet to be validated against experimental results. Will enable reduction of planetary gear vibration and noise.

Total 2282

Project AF20 Page 5 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research AF20 **FY 1999 Planned Program:** 2054 - Demonstrate quick execution (overnight turn around) for Version 2.0 of the National Combustor Code, providing an increased incentive for industry to use the code. - Complete 3-D gear crack propagation code to improve transmission safety. - Demonstrate improved high temperature mechanical property stability of SiC/SiC composite through microstructural control. - Complete experimental investigation of stator end wall blockage and fillet geometry effects performance of multistage axial compressor. These results will ultimately enable significant improvements in compressor efficiency to be realized through reductions in secondary flow losses. - Calibrate 3-D gear crack propagation code with data from Boeing single tooth bending fatigue test gear in order to improve transmission design safety. - Develop material and lead wire attachment technique for ceramic based thin film strain gauges for use to 1200°C. - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs Total 2068 FY 2000 Planned Program: - Apply particle image velocimetry to centrifugal compressor research stage at peak operating point to capture detailed flow physics associated with the onset of stall/surge. This data will enable the realization of flow physics based active stabilization and hence improved component efficiency. - Characterize the coupling between internal convection and external film cooling for turbine blades. The resulting models will provide insight into the internal cooling and film cooling heat transfer process, and ultimately improve efficiency by reducing the need for parasitic cooling flow. - Complete development of micro-electromechanical systems (MEMS) based heat flux sensor, thereby enabling high spatial resolution heat flux measurements to be made on turbomachinery airfoils. The end results are improved design and analysis codes for turbomachinery heat transfer. - Complete development of comprehensive thermomechanical life prediction model for advanced structural ceramics enabling insertion of durable structural ceramics into manned gas turbines. - Acquire data for validation of 3-D finite element analysis for spiral bevel gear thermal behavior, leading to reduced rotorcraft drivetrain weight and increased safety. - Complete cooperative project with industry to determine best gear tooth crack detection algorithms for improved rotorcraft transmission safety. - Complete development and validation of rotorcraft planetary gear dynamics code as a tool to minimize noise and vibration - Complete development of MEMS based strain gage enabling high spatial resolution measurements to be made on turbomachinery airfoils. The end results are validated performance characteristics for high temperature turbomachinery components. Total 2426 Exhibit R-2A (PE 0601102A) Page 6 of 74 Pages Project AF20

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research AF20 **FY 2001 Planned Program:** 2504 - Incorporate environmental effects in life prediction model for advanced structural ceramics, including effects due to combustion products. - Develop waverotor concept for on rotor combustion, thereby integrating high-pressure turbomachinery and combustor component functions into a single component. This cycle is projected to reduce fuel consumption by 16% and increase specific power by 18%. - Apply and assess the validity of newly developed engine weight and safety prediction algorithms. These algorithms will forecast the impact of new advanced technology on the weight and safety of new engines. - Complete development and proof-of-concept test of smart sensor system for engine component damage prediction and control. - Complete development and validation of highly reliable, integrated gear fault detection methodology for improved rotorcraft transmission safety and reliability. Total 2504 Exhibit R-2A (PE 0601102A) Project AF20 Page 7 of 74 Pages

ARMY RDT&E BUD	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)										
BUDGET ACTIVITY 1 - Basic Research			I -		IMBER AND T		Research	Science	s		ROJECT AF22
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 200 Estima		FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AF22 Research in Vehicular Mobility	446	469		474	486	495	605	666	689	Continuing	Continuing

Mission Description and Justification: This project conducts research in support of advanced military engine technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts. Advanced propulsion research will dramatically improve power density, performance and thermal efficiency for advanced adiabatic diesel engines, transient heat transfer, high temperature materials and thermodynamics. This project also supports state-of-the-art simulation technologies to achieve a more fundamental understanding of advanced high-output military engines. The subject research is directed at unique, state-of-the-art phenomena in specific areas such as: 1) non-linear ground vehicle control algorithms, using off-road terrain characteristics; and 2) instantaneous diesel engine low friction/cold start optimizations, using advanced analytical and experimental procedures. The subject efforts offer an opportunity to produce quantum Army ground vehicle performance enhancements through the use of optimized parameterization procedures.

FY 1998 Accomplishments:

- 446 Formulated state-of-the-art non-linear vehicle dynamics insights.
 - Established vehicle/human control algorithms for military systems performance enhancements.
 - Validated fundamental power train component models for unique ground vehicles.

Total 446

FY 1999 Planned Program:

- 460 Validate state-of-the-art vehicle dynamics phenomena.
 - Optimize vehicle/human control models for off-road scenarios.
 - Optimize fundamental power train characteristic phenomena using advanced simulation procedures.
- 9 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 469

FY 2000 Planned Program:

- 250 Validate advanced power train simulation algorithms.
 - Derive militarily relevant system powertrain sensitivities.
- 224 Enhance state-of-the-art, real-time vehicle dynamics understanding.

Total 474

Project AF22 Page 8 of 74 Pages Exhibit R-2A (PE 0601102A)

	ARMY RDT&E BUDGET ITEM JUSTIFIC	CATION (F	R-2A Exhibit)	DAT	February 1999
BUDGET ACTIVITY 1 - Basic Rese	earch	PE NUMBER AN 0601102A	D TITLE Defense Resea	rch Sciences	PROJECT AF22
FY 2001 Planned 1	 - Fundamentally improve unique propulsion combustion/fue - Use high fidelity non-linear validation techniques to exam 				
Project AF22	Page	e 9 of 74 Pages		Exhibit R-2	A (PE 0601102A)

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ARMY RDT&E BUD	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)										
1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences							s	PROJECT AH42			
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost	
AH42 Materials and Mechanics	1817	1647	191	9 1987	2045	2377	2520	2625	Continuing	Continuing	

Mission Description and Justification: This project funds the Army's basic research program in materials science. The goal is to establish the science base allowing the creation and production of advanced materials which will provide higher performance, lower cost, improved reliability, and environmental compatibility for Army unique applications. Emphasis is on understanding the fundamental aspects of chemistry and microstructure that influence the performance and failure mechanisms of materials. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD and Langley, VA.

FY 1998 Accomplishments:

- Designed polymer systems that possess the ability to form novel nanomolecular architectures for possible use as protective clothing, membranes and coatings.
 - Developed guiding principles and novel processing technology for repair and fabrication of composite materials using magnetic induction.
 - Validated cure simulation models for resin transfer molding of polymer matrix composites.
 - Established processing guidelines for the microstructural design of ceramic materials tailored to improve lightweight armor performance.
 - Developed flow and fracture theory for large, high rate deformation of solids under coupled electromagnetic and mechanical forces to improve armor and armament design capabilities.
 - Collaboration begun with Brunel Univ. (UK) in "adaptive methods for viscoelasticity modeling", supported by the U.S. Army Research, Development and Standardization Office, UK, and with Virginia Polytechnic Institute on "damped structures", supported by the Army Research Office.
 - Cooperative Research and Development Agreement (CRDA) activity begun with Penn State Univ. and Lord Corp., Erie, PA on computational modeling of elastomeric materials used in helicopter bearings and dampers.

Total 1817

FY 1999 Planned Program:

- 1636 Conduct fundamental experimental and modeling studies to help understand and predict the effects of constituents, fiber architecture and fiber-matrix microstructure on the low-cycle fatigue characteristics of polymer matrix composite materials.
 - Couple micro and macro models for micromechanical damage/failure prediction in thick section composites for future lightweight vehicles and ordnance.
 - Investigate the formation and effects of AlON ceramic microstructure on physical properties critical for transparent armor applications.
 - Develop models and basic guidelines for engineering surface sensitive properties of materials using energetic directed ion-laser beam techniques

Project AH42 Page 10 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **AH42** - Conduct fundamental experimental studies to determine the dynamic behavior and defeat mechanisms of conceptual armor materials subjected to multiple external excitations. **FY 1999 Planned Program: (continued)** - Leverage the cooperative work with Brunel Univ. to improve adaptive integration methods for modeling elastomeric materials and highly damped structures, and transfer in-house nonlinear viscoelastic models of elastomers to Penn. State Univ. and Lord Corp., Erie, PA. - Develop failure criteria for thick curved composites. - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs Total 1647 FY 2000 Planned Program: 1919 - Determine the synthesis-microstructure-property relationships in polymer/clay nanocomposite materials. - Refine low cycle fatigue predictive models for integrally-designed armor composite materials that include effects of material flaws and damage. - Investigate processing-microstructure effects on elastic properties of a functionally graded material. - Extend predictive models and experimental techniques for cluster beam and pulsed laser ablation deposition of protective coatings. - Investigate and develop coupled theoretical models for constitutive laws governing the high strain rate behavior of lightweight metal alloys and hybrid armor candidate materials. - Investigate transfer of elastomer modeling technology to commercial design code venders and to the aviation community, and investigate multidimensional time-space adaptive 'demeshing' techniques. - Validate bond strength through nondestructive evaluation (NDE) on selected composite structures. Total 1919 FY 2001 Planned Program: - Investigate the effects of interfacial chemistry on the engineering properties and microstructural damage/failure mechanisms of organic/inorganic nanocomposites. - Explore novel technologies for damage detection and mitigation in lightweight, multifunctional armor materials. - Investigate alternative uses of cluster beam techniques to enhance surface quality and durability in vacuum processes. - Investigate shock response and micromechanical damage/failure mechanism of a functionally graded material. - Investigate failure mechanisms in metal/ceramic hybrid materials under complex stress states and conduct two-dimensional shock experiments on novel, lightweight armor materials. - Evaluate the possible extension and application of this computational, elastomeric material modeling technology area to intelligent material systems, including electro-rheological fluids. - Initiate Phase II bond strength program to develop and validate advanced methods and hardware 1987 Total Exhibit R-2A (PE 0601102A) Project AH42 Page 11 of 74 Pages

		DATE February 1999
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Science	es

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		ARMY RDT&E BUI	OGET ITE	EM JUS	TIFICAT	TION (R-	2A Exhi	ibit)		DATE Fe	bruary 19	999
BUDGET AG	стіvітү ic Rese	arch				UMBER AND 01102A [Research	Science	PROJECT AH43		
	C	COST (In Thousands)	FY1998 Actual			FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH43 Res	search in Ba	llistics	5407	3150	4025	4131	4240	4480	4783	4962	Continuing	Continuin
	ballistic te Accomplish 5407	 Modeled the physics of adimprove charge reliability, Applied computational fluparachutes, to develop tools Measured and modeled the lightweight armor systems. 	lvanced solid jease optimizatid dynamic at to reduce des	propellant chion, and simular calculationing costs.	narge combu nplify charg n technolog	astion to deve e malfunction ies to both h	elop tools than diagnosis. igh and low	at will enable	e the design	of new prop g., munitions	ulsion conce	epts, nd
• Total	3149 1 3150	 Develop computational arnew ingredients to revolutional fluirockets, and missiles. Measure and model the computational Business Innovation 	onize the deve d dynamics are ouple effect of	lopment of find rigid body	Future high-py computation, electrical a	performance onal techniquend magnetic	solid propel les to allow j fields on arr	lants for ball prediction of mor and pro	listics applic f trajectories	eations. for advance	d guided pro	ojectiles,

FY 2000 P	4025	 Develop theoretical chemic propellants, validated by ig critical intra- and inter-mol 	nition and cor	nbustion exp	erimentatio							
Project Al	H43				Page 12 o	f 74 Pages			Exhibi	t R-2A (PE	0601102A))

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AH43 FY 2000 Planned Program: (continued)** - Couple computational fluid dynamics/thermal/rigid body dynamics tools for complex aerodynamic shapes and launch dynamics of advanced munitions. - Incorporate coupled constitutive models into the magneto-solid-mechanics version of the CTH model being developed as part of the workpackage on electro-dynamic defeat of anti-armor threats. - Perform shock wave propagation experiments in functionally graded materials to determine the effect of directionality on its shock, release, tensile and energy dissipation properties. Determine the effect of the material property gradient on wave front curvature and amplitude for general directions of propagation. Total 4025 FY 2001 Planned Program: - Refine predictive first principles of chemistry and physics-based models and 3-D interior ballistics models and apply ignition and combustion experimental data to predict ballistic properties of advanced high-performance solid propellants in propulsion systems. - Develop advanced computational models, smart munitions aerodynamic prediction capabilities, and flight vehicle control element design tools to reduce design cycle time and cost of advanced munitions. - Incorporate fundamental theory of shock propagation in Functionally Graded Materials (FGMs) into wave mechanics code and complete critical experiments to validate the model. Complete integration of FGM constitutive model to provide 3-D modeling capability for the design of FGMs that will enable lightweight AAN vehicle concepts. 4131 Total Exhibit R-2A (PE 0601102A) Page 13 of 74 Pages Project AH43

		ARMY RDT&E BUD	GET ITE	EM JUS	ΓIFICA	ΓΙΟΝ (R-	2A Exh	bit)		DATE Fe	bruary 19	999	
BUDGET AC 1 - Basic		arch				PE NUMBER AND TITLE 0601102A Defense Research Science					PROJECT AH44		
	C	COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost	
AH44 Adva	anced Sens	ors Research	3834	4410	4062	2 4156	4250	4515	4796	4957	Continuing	Continuin	
Mission Description and Justification: This project exploits new opportunities in the basic sciences underpinning the technology areas of digital and image processing modules and algorithms, optical control of radar sensors, nonlinear optical materials and devices, remote sensing, emissive materials and intelligent system distributive interactive simulations and battlefield acoustic signal processing algorithms. Research involves fundamental science and engineering principles that support survivable sensor systems, displays, and environmental monitoring, both point and remote. Monolithic and hybrid optoelectronic structures in gallium arsenide and lithium niobat are investigated as integrated processors for novel signal and radar processing and control. Diffractive and micro-optic elements are developed to enhance performance imagers and optical processors. For laser protection, nonlinear optical effects are being explored which will allow broad band protection. These nonlinear effects can all be used for optical image processing or holographic displays and storage. FY 1998 Accomplishments: 1048											butive vivable niobate mance of s can also ototype.		
FY 1999 PI •		- Demonstrate feasibility of o											
Project AH	1 44	- Investigate and manipulate	the lumineso	cence proper		o-crystalline _l of 74 Pages	phosphors a	nd organic m		t R-2A (PE	0601102A)		

		ARMY RDT&E BUDGET ITEM	JUSTIFICATION (R-2A Exhi	bit) DATE Febru	uary 1999
BUDGET A			PE NUMBER AND TITLE	•	PROJECT
1 - Basi	ic Rese	arch	0601102A Defense R	Research Sciences	AH44
		- Fabricate and characterize binary, subwavel	ength diffractive lens.		
FY 1999	Planned F	rogram: (continued)			
		- Investigate various optical and electro-chem		conment sensing.	
		- Investigate optical interferrometric technique			
•	2153	- Develop a real-time technique for extracting			
		- Investigate the possibility of performing ima	age processing using the mathematics of parti	al differential equations implemented as	s a real-time
		parallel Analog opto-electronic processor.			
		- Establish a correlation between trajectory lil		exponent and develop a technique to eva	luate closure
_	1433	models and their trajectories using Lyapunov - Explore and evaluate new imaging techniqu		, configuration	
•	1433	- Calculate the cross-range super-resolution v			
•	85	Small Business Innovation Research/Small B			
Total	4410	Sman Business innovation research/sman B	usiness reciniology Transfer (SBIN/STTR/)	Tograms	
FY 2000 P	Planned Pr	ogram:			
•	1529	- Initiate materials integration for improved h	nardened smart sensor incorporating optical/d	ligital imaging.	
		- Determine optimal luminescence material for			
		- Investigate designs for low cost, low power		pace Sensor System (WEBS).	
		- Integrate binary, subwavelength lens with ve			
		- Record and fix grantings in moving 3D hold			
	016	- Develop remote detection via laser particle			
•	816	- Report on analysis of dielectric mine measu			
_	1717	Investigate cross-range super-resolution of cUtilize fuzzy logic to control level of terrain		a maintaining a constant frame rate	
•	1/1/	- Investigate and report on techniques for the			
		 Utilize Lyapunov exponents based closure n 			ontical cancore
Total	4062	- Othize Lyapunov exponents based closure in	model to assess the improvement of turbulence	c calculations as related to acoustic and c	optical schsors.
Y 2001 P	Planned Pr				
•	2478	- Design and demonstrate low power high bri			
		- Deliver nonlinear optical protection cell to 7			
		- Characterize new class of point and remote			
		- Report on UWB ground penetrating radar u	• •		
Project Al	H44		Page 15 of 74 Pages	Exhibit R-2A (PE 060)1102A)

	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								
BUDGET ACTIVIT			PE NUMBER AND TITLE	PROJECT					
1 - Basic R			0601102A Defense Research Science						
		- Extend capabilities of S-MUSIC and blind deconvolution	super-resolution algorithms and demonstrate applicabil	ty using field data.					
FV 2001 Plans	nad D	ogram: (continued)							
		- Demonstrate real-time rectification of sensor imagery utili	izing features with the scene.						
		- Investigate the effects of turbulence induced phase and int		nd identify techniques to reduce					
Total 4	156								
Project AH44		Page	e 16 of 74 Pages Exhibit	R-2A (PE 0601102A)					

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **AH45** FY1998 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** FY 1999 Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete AH45 Air Mobility 1836 1880 1991 2044 2102 2528 2807 2913 Continuing Continuing A. Mission Description and Justification: Basic research in aerodynamics and avionics as applied to rotary wing aircraft. Analysis, code development, and test and evaluation are conducted on rotor unique aerodynamics, dynamics, performance, and aircraft performance and acoustics. **FY 1998 Accomplishments:** - Completed scale model hover testing with a pneumatically actuated, trailing edge flap for high lift. - Developed and validated the HELIX-II gear design tool, which includes accelerated vorticity embedding method to prevent numerical dissipation problems. - Developed advanced aeroelastic concepts for damperless rotor systems to control ground/air resonance. - Developed a grid-adaptive, unstructured overset scheme for the OVERFLOW code to improve the resolution of the rotor wake system. - Integrated a panel methodology into an integrated aeromechanics analysis to model aerodynamics influence of fuselage and wing/empennage. 1836 Total FY 1999 Planned Program: - Develop structure/actuator concepts for application to multi-controller active, on-blade systems for low vibration rotorcraft. - Design and fabricate a scale model equipped with oscillatory blowing to control flow separation. - Fabricate and test an isolated, instrumented baseline rotor for increased payload, reduced noise and vibration. - Develop stereo particle image velocimetry for rotor wake measurements . - Develop advanced aeroacoustic prediction code using parallel computer. - Develop pressure sensitive paint technique for blade surface pressure measurement. - Perform forward flight aeroelastic stability testing of swept tip hingeless rotor blades. - Investigate aeroelastic and dynamic response of on-blade elevon controls for vibration reduction. - Design, fabricate, and test a scale model equipped with oscillating blowing to control flow separation. - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs Total 1880 FY 2000 Planned Program: 1991 - Complete the development of stereo image velocimetry technique. - Complete detailed rotor wake geometry measurements during blade/vortex interaction using stereo image velocimetry technique.

Exhibit R-2A (PE 0601102A)

Project AH45

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AH45** FY 2000 Planned Program: (continued) - Complete an axial-flight wind tunnel test to separate induced power from total power measurement. - Design and fabricate scale model rotor blades equipped with oscillating blowing to control flow separation. - Perform analytic validation of swept tip blade stability characteristics. - Conduct parametric studies of active control with on-blade elevons for low vibration rotors. 1991 Total FY 2001 Planned Program: 2044 - Complete rotor aerodynamic and acoustic codes using scalable software. - Complete hover test using model blades equipped with oscillating blowing to control flow separation. - Investigate aeroelastic coupling characteristics for improved rotor stability. - Validate analytical methods for on-blade control vibration characteristics. 2044 Total Exhibit R-2A (PE 0601102A) Project AH45 Page 18 of 74 Pages

		ARMY RDT&E BUD	GET ITE	EM JUS	TIFIC	ATI	ON (R-	2A Exhi	ibit)		DATE Fe	bruary 1	 999
BUDGET AC		arch			PE NUMBER AND TITLE 0601102A Defense Research Science					Science	PROJECT AH47		
	C	COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 200 Estima		FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH47 App	olied Physics	Research	2910	2643	3	3080	3177	3275	3734	4099	4269	Continuing	Continuing
test their po application the Army c	erformanc as for Arm capitalize c ents in sys		etronic composes, tactical with actor optoelectronics can put of the Composition of the C	onents and s ireless commetronics becarovide. hed material pal Positioni oxidized Voolyte based 1	ubsystem nunication nuse of the s for eye ng System ertical C high ene	ms will ons, a the pot e-safe em (G Cavity ergy ca	Il be develound optical stential for vertical for vertica	oped that are signal procest vastly reduce effinders. In and problem itting Laser burst comme	of importantssing. From an existence of system sizes of the system sizes of the system with GPS of the system with GPS of the system with GPS of the system	ce for Army a logistical e, weight, a MAGR.	y systems. T point of view nd cost as we oplications.	hese include wit is imporell as for the	tant that drastic
Total FY 1999 P Total	2910 Planned Pr 2143 483 17 2643	rogram: - Initiate growth and process - Develop realistically correct - Develop strain-effect-enhar - Synthesize new anode mate - Develop new electrolyte so - Synthesize/evaluate new ca - Small Business Innovation	et algorithm faced wave-guerial for highelivents for capathodic electr	for GPS posi- nide modular er energy rec- pacitors and ocatalysts for	tioning a tors and chargeab recharge or high p	and ti ampli ble baseable eable perform	ime transfe ifiers. atteries for a lithium-ior mance metl	r within the reduced weign batteries. hanol fuel ce	framework of the ght and cost.	of general re	elativity.	S.	
FY 2000 P	Planned Pa 2480	rogram: - Demonstrate feasibility of C - Develop InAs/GaSb based		•		ructure	es.						
Project Al	H47				Page 1	19 of 7	74 Pages			Exhibi	it R-2A (PE	0601102A)	l

	,	ARMY RDT&E BUDGET ITEM J	USTIFICATION (R-2A Exhi	bit) DATE Febr	uary 1999
BUDGET AC 1 - Basi		arch	PE NUMBER AND TITLE 0601102A Defense i	Research Sciences	PROJECT AH47
FY 2000	Planned I	rogram: (continued)			
•	600	 Implement new micro-cavity structures in adva Explore semiconductor strain effects and wideb Investigate/eliminate side-reactions limiting stolithium-ion batteries. Synthesize new solvent for capacitor electrolyte 	and gap physics for future opto-electronic orage and low temperature performance of the to enable low temperature operation in b	f new, more energetic anode material for ourst communications applications.	or rechargeable
Total	3080	- Evaluate conductivity and chemical stability of	new membrane electrolytes for high perfo	ormance fuel cell.	
FY 2001 P	Planned Pr	ogram:			
•		 Demonstrate electrically pumped interband qua superlattice detector. Initiate development of wideband gap active de 	•	ting characteristics and develop InAs/G	aSb based
•	641	 Formulate solid electrolyte for rechargeable lith Formulate new high voltage low temperature el Develop improved Li/polymer battery chemistry Develop improved chemistry for direct methano 	nium battery with high energy density/good lectrolyte for high performance electroche y for long storage, high energy density ba	emical capacitor.	
Total	3177	- Develop improved chemistry for direct methand	or ruer cen.		
Project AI	H47		Page 20 of 74 Pages	Exhibit R-2A (PE 06	601102A)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)										999
BUDGET ACTIVITY 1 - Basic Research		PE NUMBER AND TITLE 0601102A Defense Research Sciences							P A	
COST (In Thousands)	FY1998 FY 1999 Actual Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cos	
AH48 Battlespace Information & Communications Res	6709	5614	6762	6940	7126	7568	8039	8523	Continuing	Continuir
associated with using standardized protocols and comobile nodes and infrastructure, bandwidth-constructure, bandwidth-construc	ined commu and informa e load on the project also s	nications at a tion warfare commande upports the A	ower echelo threats. The r, improve the Army High	ons, diverse in telligent he timeliness Performance	networks wi systems for s, quality and	th dynamic t C4I research d effectivene	copologies, h h will focus ess of actions	nigh level mu on developir s and in the le	lti-path intents ong the agent ong run redu	rference uce the
FY 1998 Accomplishments:										
• 5122 - Evaluated through simulation reconfiguration.	on secure mo	bility manag	gement tech	niques for m	obile host pi	rotocols that	support dyn	amic tactical	network	
- Through simulation software - Evaluated multiple intellige										N

- command supports systems.
- Investigated and prepared a paper on the issue related to the interaction of humans and intelligent agents.
- Outlined requirements and approach for the development of an Alert Agent that will focus user attention to key events.
- Initiated research to develop a theoretical foundation for cooperative intelligent agents to achieve the AAN goal of mental agility.
- Developed advanced 3-D computational techniques capable of modeling coupled fluid-structure around flexible membranes. This technology is important for modeling the deployment and flight of large ram air parachutes. The Air Force and NASA have expressed interest in the results of this work and are now collaborating with the AHPCRC and Natick RDEC on the development of this technology.
- The work on two-phase fluid mixing of sloshing fluids and their effect on vehicle stability was expanded to include collaboration with researchers at TARDEC.
- Developed an efficient fully parallelized version of the F3D code capable of solving steady state flow problems on 50 million point grids in a practical time.

Page 21 of 74 Pages Exhibit R-2A (PE 0601102A) Project AH48

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 **BUDGET ACTIVITY** PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AH48** FY 1998 Accomplishments: (continued) - A production version of parallel METIS was released. A workshop on mesh generation techniques was held with over 60 participants from the Army and DoD in attendance. Attendees were briefed on the capabilities of METIS and paraMETIS. These libraries are now being used by researchers at DoD Laboratories. - Software was developed to study pore-scale velocity distributions in regular and random sphere packings using high-resolution, 3D simulation. This work was conducted in conjunction with CEWES. 6709 Total **FY 1999 Planned Program:** 3540 - Validate the performances of secure mobility management techniques for mobile host protocols that support mobile ad-hoc network configurations. - Investigate survivable information architectures for information protection that addresses security, software reliability, data integrity, and system recoverability. - Define mobile distributed multiple access Anti-Jam (AJ) communication networks for brigade and below. - Validate and evaluate through simulation software intelligent agents that can detect information operations on combat networks. - Develop hierarchical digital modulation algorithms for classification and identification of signals on battlefield. - Develop robust spatial diversity combining algorithms for tactical communications - Develop algorithms for performing channel and source coding for tactical communications, with error correcting codes, that are capable of operating in high-bit error battlefield environments. 1987 - Utilize University of Maryland developed intelligent agent architecture to develop user alert agent technology. - Continue investigation of the interaction of humans and intelligent agents with a focus of agent autonomy. - Outline requirements and approach for an agent that monitors event detection and synchronization over bandwidth limited channels. - Continue investigation of theoretical foundation for cooperative intelligent agents that will underpin the Army After Next (AAN) Command Support System. - Investigate the application of soft computing techniques (fuzzy logic, neural nets, etc.) to enable agents to deal with uncertainly. - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs 5614 Total FY 2000 Planned Program: 4219 - Refine secure mobility management techniques for mobile host protocol that support mobile ad-hoc networking on the move. - Refine intelligent agents for vulnerability assessment of dynamic tactical networks. - Evaluate concept for mobile distributed multiple access Anti-Jam (AJ) communication networks for brigade and below. - Complete investigation of survivable information architectures for information protection that address security, software reliability, data integrity and system recoverability. Exhibit R-2A (PE 0601102A) Project AH48 Page 22 of 74 Pages

BUDGET AC	TI\ //T\ /		ICATION (R-2A Exhibit)	February 1999
1 - Basic		arch	PE NUMBER AND TITLE 0601102A Defense Research Scien	PROJECT
		- Evaluate and refine hierarchical digital modulation algo	rithms for classification and identification of signals	on battlefield.
FY 2000 I	Planned I 2543	Program: (continued) - Continue development of spatial diversity combining algorithms for performing channel a error battlefield environments. - Begin validation of intelligent agent architecture by test	and source coding for tactical communications that are	
		Processing Technology Science and Technology Objective - Publish a paper on the critical aspects of human agent in - Assess the extensibility and adaptability of the intelligent defined mission plan Continue investigation to expand theoretical foundation agent to agent communication Evaluate the use of soft computing approaches to enhance - Assess the application of intelligent agent technology to	nteraction that must be considered in the development nt agent architecture to the synchronization of physical for cooperative intelligent agents by focusing research ce the ability of agents to deal with uncertainty.	al and software agents against a user the on the language that will facilitate
Total	6762	6 6 6 6		
FY 2001 Pl	anned Pr	rogram:		
•	4080	 Demonstrate efficient algorithms for Internet protocols of Demonstrate utility of hierarchical digital modulation ale Utilize a mobile ad-hoc network to interconnect a team Demonstrate source and channel coding for tactical com Validate hierarchical digital modulation algorithms for one Validate performance of spatial diversity combining algorithms 	gorithms by testing, identifying and classifying comp of physical agents and higher echelons to demonstrate amunications in high bit error battlefield environment classification and identification of signals on battlefie	e improved information flow. s
•	2860	 Transition to 6.2 a set of intelligent agents for mission p In collaboration with Advanced Information Processing situation display. Evaluate the robustness of the theoretical foundation for assessing the network vulnerability in conjunction with a validate the performance of natural language and conternal contents. 	planning, rehearsal and status monitoring of a physical STO, demonstrate the state of physical or software a cooperating agents by using its architecture and contigents that monitor the execution of the mission.	gents through a 2D/3D battlespace
Total Project AH	6940			nibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **AH52** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete AH52 Equipment for the Soldier 857 866 944 981 1015 1222 1306 1364 Continuing Continuing Mission Description and Justification: Basic research focused on five core technology areas critical to the Soldier System: mathematical modeling, physical performance measurement, polymer science/textile technology, biotechnology and food technology. Research is targeted toward enhancing the mission performance, survivability, and sustainability of the soldier by advancing the state of the art in defense against battlefield threats and hazards such as ballistics, chemical agents,

FY 1998 Accomplishments:

857

857 - Mathematically modeled the energy dissipating effects of textile systems to predict the behavior of newly designed textiles.

lasers, environmental extremes, and shortfalls in the availability of nutritious, performance sustaining rations essential to the health and well-being of soldiers.

- Characterized polymeric "interphases" for optimization of ballistic and chemical agent protective properties.
- Incorporated energy converting proteins into electroactive polymer matrices for enhanced signal transduction in optical devices.
- Leveraged the Multidisciplinary University Research Initiative (MURI) for "functionally tailored fibers and fabrics" with the new electrospinning technology and initiated efforts to advance the state of the art of that technology.
- Formulated and processed meat proteins to optimize microwaving as a new sterilization technique for military rations.
- Measured and enhanced individual soldier mobility and related physical performance through biomechanics, anthropometry and nutrition assessments.

Total 857

FY 1999 Planned Program:

866

- Screen new materials using "electrospinlacing" technology for the production of "seamless" multifunctional protective clothing.
- Validate mathematical models of textile damage effects from abrasion, strain, and ballistic impacts.
- Incorporate production variables into the assessment of physical and chemical factors affecting non-linear optical behavior of candidate laser eye protective material.
- Apply sophisticated analytical methodologies to formulated meat proteins to determine the effects of microwave sterilization of military rations.
- Quantify soldier physical performance emphasizing biomechanical and anthropometric parameters of the soldier's load.
- Characterize the form and function of polymer/clay nanocomposites relevant to high performance, multifunctional fabrics and structures for the protection of the future soldier.
- Conduct computational experiments to provide validated model algorithms that predict the performance of airdrop systems using DoD High Performance Computing resources.

Total 866

Project AH52 Page 24 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AH52 FY 2000 Planned Program:** 944 - Evaluate the mechanical properties of candidate nanocomposites to better understand functionality for lightweight soldier applications. - Electrospin blended polymers for further evaluation as candidates for multifunctional textile applications. - Extend the stability and functionality work on meat protein dynamics to include biopolymers and synthetic polymers yielding a broader application to enhanced soldier performance and injury recovery. - Investigate the structural and fluid dynamics of airdrop systems leading to development of an airdrop virtual proving ground. 944 Total **FY 2001 Planned Program:** 981 - Downselect candidate nanocomposites by varying composition and processing, yielding materials suitable for scale-up in 6.2, addressing lightweight Army After Next soldier requirements. - Transition blended electrospun fibers to 6.2 for scale-up and woven fabric applications. - Numerically couple the structural and fluid dynamics of airdrop systems using High Performance Computing yielding new technology to reduce life cycle costs of airdrop systems. 981 Total Exhibit R-2A (PE 0601102A) Page 25 of 74 Pages Project AH52

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **BH57** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete BH57 Scientific Problems with Military Applications 48713 52727 50713 51786 52798 58179 59685 61620 Continuing Continuina A. Mission Description and Justification: This extramural research project seeks to capture and exploit new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's future operational capabilities. The Army Research Office maintains a strong peer-reviewed scientific research program through which technological improvements to warfighting capability can be assessed and implemented. Included are research efforts of scientific study and experimentation directed toward increasing knowledge and understanding in fields related to long-term national security needs and covering the physical sciences

FY 1998 Accomplishments:

students yearly, and supports research at over 100 institutions in 41 states.

• 23872 - Advanced materials research in the electrospinning of nanofibers demonstrated increased protection for the soldier from chemical and biological agents as well as lighter and more comfortable clothing.

(physics, chemistry, biology, and materials sciences), the engineering sciences (mechanics, aeronautics, electronics, and mathematical and computer sciences), and the environmental sciences (atmospheric and terrestrial). It covers approximately 575 research grants and contracts with leading academic researchers and over 850 graduate

- Advanced chemistry research in supercritical water oxidation produced in a reactor model for the destruction of chemical weapon agents and hazardous munitions wastes.
- Advanced physics research has produced the first mid-infrared quantum cascade laser to operate at room temperature. This type of laser is an excellent candidate for infrared scene projection and for sensors to detect toxic gases.
- Through advanced biosciences research, developed the world's tiniest bacterial flaggellar motor which is providing insights into the design of miniature mechanical devices as well as mechanisms for energy conversion.
- 24846 Advanced electronics research demonstrated the first omni-directional quasi-optical modulated oscillator array for antennas for mobile communications.
 - Advanced research in mathematical and computer sciences developed a successful game theoretic approach for handling conflict resolution in multiagent intelligent systems with applications such an autonomous air traffic management.
 - Advanced signal processing techniques which take into account the statistical nature of clutter effects of buried mines reduced the false alarm rates in electromagnetic induction mine detection systems by a factor of four.
 - Improved numerical simulations of turbulence in atmospheric boundary layer using an ultrahigh frequency radar system, mitigating environmental effects and thereby improving precision strike capabilities and battlefield visualization.

Total 48718

Project BH57 Page 26 of 74 Pages Exhibit R-2A (PE 0601102A)

	,	RMY RDT&E BUDGET ITEM .	JUSTIFICATION (R-2A Exhi	bit) DATE Feb	ruary 1999
BUDGET A	ACTIVITY Sic Rese	arch	PE NUMBER AND TITLE 0601102A Defense R	Research Sciences	PROJECT BH57
FY 1999	Planned F	rogram:			
•	22545	 Advance materials research in nanocrystalline weight and increase the performance of compo Advance chemistry research in dendrimers an Advance physics research to exploit the prope Advance biological sciences research in gene Advance electronics research in bandwidth ar communications. Advance research in stochastic geometry to so and for evaluating the strength of composite m Advance software and knowledge-based scienenvironments. Advance fluid dynamics research in unsteady 	nents in rotorcraft and land combat vehicles and hyperbranched polymers to provide a new erties of nanometer-sized clusters of atoms to expression to determine the neural mechanish power efficient modulation and doding to olve military problems related to the study of aterials in Army vehicles.	class of nanoscopic building blocks for construct materials with unique functions that facilitate alertness and attents increase bit-rate throughput for tactical factorial are described in the control of the control	For Army materiel. etionality. tion in the soldier. eal wireless of maneuverability digital information
•	4700	speed.Enhance science, mathematics and engineerir research in areas critical to the Army through t			and engineering
• Total	1905 52727	- Small Business Innovation Research/Small B			
FY 2000	Planned F	rogram: - Advance biometrics research by exploring syn	nthetic processing routes to laminated ceram	nic-polymer composites for improved a	armor.
	21100	 Advance chemistry research to create reactive soldiers and equipment. Advance physics research to apply quantum experimentation storage, communication, and processed and equipment. Advance biosciences research to understand the survival in harsh environments. 	re "smart" polymers that can react to externate ffects such as entanglement and nonlocality essing.	al stimuli for thermal and visible signate to the development of enhanced technique.	iture reduction of
Project B	BH57		Page 27 of 74 Pages	Exhibit R-2A (PE 06	601102A)

		ARMY RDT&E BUDGET ITEN	JUSTIFICATION (R-2A Exhil	oit) DATE Febr	uary 1999
BUDGET AC	-	arch	PE NUMBER AND TITLE 0601102A Defense R		PROJECT BH57
•	26247	 Advance electronics research by developin tactical mobile communications networks. Advance research in computational mather ballistics and rotorcraft, and for armor pener. Advance engine combustion research in the 	g algorithms for efficient multicast distribution matics to model physical and operational phenotration mechanics. ermal management in ultra-low heat rejection of	and broadcasting, and for scalable round omena for Army applications such as fl environments to improve propulsion in	uid dynamics for Army vehicles.
Total	50713	- Conduct research in quantum computations	al analysis to develop revolutionary devices wh	ich can solve several types of "unsolva	ble" problems.
FY 2001	Planned F	rogram:			
•	24991	 Advance materials research to improve and ceramics with superior mechanical properties Advance chemistry research to study moles Advance physics research to self-assembly Advance biological sciences research to me 	cular aging as a materials failure mechanism. 3D photonic band gaps for potential application etabolically engineer enzymes, macromolecules	on to single photon communications. s and receptors to biologically remediat	te toxic materials.
•	26795	communications networks. - Advance research in computational geome management. - Advance mechanical sciences research by fluid based dampers for stability augmentation	try for discrete mathematical problems related exploring the feasibility of smart active/passive on of bearingless helicopter rotor blades.	to robotics, autonomous navigation and	d battle
Total	51786				
Project BI	H57		Page 28 of 74 Pages	Exhibit R-2A (PE 06	01102A)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)									February 1999		
BUDGET ACTIVITY 1 - Basic Research		PE NUMBER AND TITLE 0601102A Defense Research Science				Science	PROJECT AH66				
COST (In Thousands)	COST (In Thousands) FY1998 FY 1999 FY 200 Actual Estimate Estimate			FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost	
AH66 Advanced Structures Research	1320	1207	1	1411	1459	1508	1607	1875	1958	Continuing	Continuing

Mission Description and Justification: This project is a joint Army/NASA effort that includes structures technology research into: structural integrity analyses; failure criteria; inspection methods which address fundamental technology deficiencies in both metallic and composite Army rotorcraft structures; use of composite materials in the design and control of structures through structural tailoring techniques; rotorcraft aeroelastic and aeromechanical stability; helicopter vibration (rotating and fixed systems); design and analyses of composite structures with crashworthiness as a goal; and the control of aircraft interior noise levels. These areas have application to the development of design tools for improved helicopter structures and dynamic response. This structures-focused technology includes reductions in vehicle vibratory loads, improved vehicle stability, advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, and long-term development of an integrated stress-strength-inspection technology. These technologies will extend service life, reduce maintenance costs, and enhance the durability of existing and future Army vehicles. The improved tools and methods will enable the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms, and ultimately result in safer, more affordable vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground structures basic research within the DoD. No related effort is being conducted within DoD.

FY 1998 Accomplishments:

- Completed design and fabrication of integral active twist rotor system for vibration reduction, modifications to the ARES testbed, and CAMRAD-II analyses to guide wind tunnel experiments.
 - Completed analytical investigation of effects of rotor blade aeroelastic parameters on rotor loads, and design model baseline rotor blades.
 - Modified comprehensive tilt rotor analysis for predicting stability of free-flight system including antisymmetric wing modes and completed aeroelastic response studies of tilt rotor systems with active controls for stability augmentation.
 - Published results of experiments to study scaling effects in tensile coupons under large deformation, completed draft of paper on state-of-the-art in scaling of composite materials and structures, and retrofitted second full-scale Lear Fan aircraft with energy absorbing subfloor beams.
 - Validated damage resistance and residual strength models for low velocity impact of stitched composite panels.
 - Performed parametric studies to develop design criteria for rotorcraft flexbeam geometry anomalies.
 - Validated 3D Finite Element Analysis (FEA) composite flexbeam strength and fatigue life predictions for combined tension/torsion loading.
 - Investigated benefits of secondary adhesive bonds and 3D reinforcements to increase composite stringer strength.
 - Conducted parametric studies to determine influence of flexbeam layup and material form on strength and fatigue durability
 - Evaluated structural parameters to understand and control crack growth geometry in stiffened panels.

Total 1320

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DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AH66** FY 1999 Planned Program: 1203 - Develop improved multiblade formulation for comprehensive analysis, and validate dynamic and aeroelastic predictions for gimbaled tiltrotor; and under CRDA with Penn State, extend aeroelastic-tailoring studies for soft-inplane tilt rotor systems. - Publish test standards to measure delamination onset and fracture toughness of composite laminates, and develop probabilistic method for analyzing low velocity impact resistant in composite panels. - Develop fatigue analysis for arbitrary flexbeam layup under combined tension/torsion loads, and 3D damage primitives for matrix crack induced delamination failures. - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs Total 1207 FY 2000 Planned Program: - Develop experimental design of the wind tunnel test of twist actuated active rotor system 'open loop' configuration. - Publish results of actively controlled stability augmentation on tiltrotor configuration, and correlate with predictions from several analytical methods. - Validate bond strength NDE on selected composite structures. 1411 Total FY 2001 Planned Program: - Evaluate forward flight characteristics in wind tunnel test of twist actuated active rotor system in 'open loop' configuration. - Incorporate active control and smart material analytical models into comprehensive analysis. - Validate analytically modeled advanced fuselage concepts for future composite aircraft. - Complete thin-skin sandwich residual tension/compression biaxial tests. Total 1459 Exhibit R-2A (PE 0601102A) Page 30 of 74 Pages Project AH66

ARMY RDT&E BUI	OGET ITE	M JUST	TIFICA	ATION (R-	2A Exhi	bit)		February 1999				
BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences									PROJECT BH67			
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate		FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost		
BH67 Environmental Research - Army Material Cmd	3305	3235	35	529 3586	3653	4069	4163	4363	Continuing	Continuin		

Mission Description and Justification: This project focuses basic research on innovative technologies for both industrial pollution prevention (P2) that directly supports the Army industrial base and for non-stockpile chemical warfare (CW) site remediation. The objective of the pollution prevention work is to invest in next generation manufacturing, maintenance, and disposal methods that will result in significantly reducing the usage of hazardous and toxic substances and their associated costs. The goal is to decrease the overall life-cycle costs of Army systems by 15-30% through the application of advanced pollution prevention technologies. The CW remediation efforts concentrate on the application of biotechnology in the characterization and physical clean-up of agent contaminated soils and groundwater. The goal is to reduce the cost of remediating a site by at least 50% verses the use of conventional methods. Pollution prevention thrusts include: environmentally acceptable advanced non-radioactive, non-toxic and lightweight alternative structural materials to enhance weapon system performance; substitutes for ozone-depleting chemicals as solvents, refrigerants, and firefighting agents for military unique applications; energetic synthesis and process improvements to eliminate the use of hazardous materials and to minimize the generation of wastes from manufacturing operations; and surface protection alternatives to hazardous paints, cadmium, chromium, and chromate conversion metal and composite surfaces. CW thrusts include establishing the ecotoxicity of CW compounds, environmental fate and effect of CW compounds in soils and biodegradation of CW compounds. This project is linked to the Tri-Service Environmental Quality R&D Strategic Plan and addresses environmental technology requirements addressed in that plan.

FY 1998 Accomplishments:

- 1978 Developed optimized microbial consortia to biodegrade CW agents/products.
 - Characterized the ability of various supercritical formulations to effectively solubilize various organic polymeric binders (e.g., Viton-A, Hytemp) during the processing of pyrotechnics
 - Developed corrosion-resistant coatings, and plasma based decoating technologies.
- 1327 Completed fabrication and examination of specimens prepared for hollow, cylindrical coating targets.
 - Continued bioceramics Langmuir-Blodgett studies, reverse micelle, or other suitable systems to mimic natural processes.
 - Conducted aqueous processing studies with elastomeric proteins for coatings.

Total 3305

FY 1999 Planned Program:

- 704 Investigate new nanoscale composites of montmorillonite clay in polyesters and nylon to increase production and crystal type.
 - Modify aqueous based coatings to optimize functional properties for specific applications such as attaching peptides to polymers to accelerate chemical/biological warfare agent degradation.
- 791 Optimize techniques for supercritical fluid triple-base demil/recycling. Transition to applied research in FY 2000.

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		ARMY RDT&E BUDGET ITEM .	JUSTIFICATION (R-2A Exhib	Dit) DATE Febru	uary 1999
BUDGET AC			PE NUMBER AND TITLE	•	PROJECT
1 - Basi	ic Rese	arch	0601102A Defense R	esearch Sciences	BH67
•	680 990 70	rogram (continued): - Identify techniques for accelerating formation - Complete fabrication and examination of spectrospector of the complete characterization, evaluation, and more research in FY 2000. CMS device may be critically the complete statement of the complete characterization of the com	cimens prepared with wire-wrapped, solid, c nodel validation of a Cylindrical Magnatron S ical capability needed to apply materials instead oal.	ylindrical, coating targets. Sputtering (CMS) device and transition ead of heavy metals to components. El	
Total	3235				
FY 2000 P Total	Planned Pr 3529 3529	ogram: Optimize environmentally benign CL-20 synt Continue model development and test and ev Investigate candidate biodegradable materials methods. Complete studies of self-assembled monolaye Develop Soil Ecotoxicological Database for la	aluate large caliber target configurations. s for incorporation in montmorillonite clay na er-topcoat adhesion, and use of plasma surface	anocomposites produced by melt extrusted treatment for improved adhesion.	
FY 2001 P	Planned Pr	ngram•			
•		 Produce CL-20 and military grade 2,4-DNT a Apply selected targets to medium and large ca Characterize microstructural and performance Optimize Soil Ecotoxicological Screening Bio Characterize the chemical resistance and physiprimer-topcoat systems. 	aliber gun tubes for application of coatings we e properties of ceramic materials produced by oassays, and predictive capabilities, for labil	which will be test fired. y biomimetic processes. e CW Agent Compounds in soils.	eavy-metal based)
Total	3586				
Project BI	H67		Page 32 of 74 Pages	Exhibit R-2A (PE 060	01102A)

	1	ARMY RDT&E BUD	GET ITE	M JUS	TIFICA	ATION (R-	-2A Exhi	ibit)		DATE Fe	bruary 19	999
BUDGET ACTIV		arch				NUMBER AND 601102A	es	PROJECT AH68				
	C	OST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate		FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH68 Process	ses in Po	Illution Abatement Technology	316	370	3	377	382	451	459	478	Continuing	Continuing
the degradatio treatment syste	n and tems for ts and	and Justification: This project reatment of hazardous wastes of both cleanup of existing hazarsmokes. This project supports hments: - Provided implementation guidence - Developed a program to det degradation rates. (WES)	on military in rdous waste applied rese uidance on n	nstallations. sites and con arch efforts nicrobial des	This resentrol of furnither the second of th	earch is used to ture hazardous m Element 060 of TNT in soils	o obtain basic s waste gener 02720A, Pro	c technical in ration. Wast jects AF25 a Waterways	nformation res of concerund DO48.	necessary for n include ex	the design of plosives, pro	of opellants,
Total	316	- Completed studies on explo	sives biopro	cessing in fl	ow throug	gh bioreactors	(U.S. Army (Construction	Engineering	g Research L	aboratories	– CERL).
FY 1999 Plan	nned P	rogram•										
• Total		 Determine factors regulating for regulation. (WES) Complete minimal growth r Small Business Innovation 1 	equirements	for bacteria	involved	with destructi	on of energe	tic wastes (C	-	on, and deve	lop concept	ual model
FY 2000 Plan	ned Pi	ogram:										
•	370	O	_							isolating and	d characteriz	ting
Total	370				<i>6 6</i>			r	(-)			
Project AH68	3				Page 33	of 74 Pages			<u>Exhi</u> bi	t R-2A (PE	0601102A))

		ARMY RDT&E BUDGET ITEM JUS	TIFICATION (R-2A Exhibit)	DATE Feb	ruary 1999
BUDGET ACT 1 - Basic		arch	PE NUMBER AND TITLE 0601102A Defense Resea	arch Sciences	PROJECT AH68
FY 2001 Pla	anned Pr	ogram:			
•	377	 Determine physiological conditions necessary for oprocesses to obtain enzyme stability and effectiveness Determine the role of hydrogen cycling in explosive 	s. (WES)	ess of cell-free enzyme systems.	, develop basic
Total	377	Determine the role of hydrogen eyemig in explosiv	e introreduciuse enzymes. (ezike)		
Project AH	68		Page 34 of 74 Pages	Exhibit R-2A (PE 0	601102A)

Item 2

ARMY RDT&E B	February 1999									
BUDGET ACTIVITY 1 - Basic Research		PE NUMBER AND TITLE 0601102A Defense Research Science					PROJE S BS04			
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS04 Military Pollutants and Health Hazards	535	572	625	635	645	757	776	800	Continuing	Continuin

Mission Description and Justification: This project provides basic research in innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes. These new testing techniques will help to prioritize hazardous waste and waste treatment technologies and screen new Army chemicals for potential toxic effects. The work is conducted at U.S. Army Center for Environmental Health Research (CEHR) and U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM).

FY 1998 Accomplishments:

- Initiated development, improvements, and intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods (CEHR).

- Identified additional sentinel biomonitoring systems for toxicity hazard assessment. (CEHR)
- Completed cross-species extrapolation of results from immunotoxicity studies in mammalian and non-mammalian bioassay systems. (CEHR/CHPPM)

Total 535

FY 1999 Planned Program:

- Continue to develop, improve, and perform intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods. (CEHR)
 - Identify additional sentinel biomonitoring systems for toxicity hazard assessment. (CEHR)
 - Transfer intralaboratory validated sentinel methods to PE 0602720A, Project A835 for interlaboratory and field validation and inclusion in an integrated toxicity hazard assessment package. (CEHR)
- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 572

FY 2000 Planned Program:

- 625 Identify additional sentinel biomonitoring systems for immunotoxicity and reproductive hazard assessment (CEHR).
 - Continue to develop, improve, and perform intralaboratory validation of specific sentinel environmental toxicity hazard assessment methods for immunotoxicity and reproductive toxicity. (CEHR)
 - Transfer intralaboratory validated sentinel methods for immunotoxicity assessment to PE 0602720A, Project A835 for further interlaboratory and field validation and inclusion in an integrated toxicity hazard assessment package. (CEHR)

Project BS04 Page 35 of 74 Pages Exhibit R-2A (PE 0601102A)

		ARMY RDT&E BUDGET I	TEM JUSTIFICATION (R-2A Exhibit)	DATE Feb i	ruary 1999
BUDGET ACTI			PE NUMBER AND TITLE		PROJECT
1 - Basic		earch	0601102A Defense Rese	earch Sciences	BS04
Total	625				
FY 2001 Pla	nned P	rogram:			
•	635	 Continue to develop, improve, and primmunotoxicity and reproductive toxi Initiate further development, improneurobehavioral. (CEHR) Transfer intralaboratory validated se 	ems for neurobehavioral toxicity hazard assessment. (CEH berform intralaboratory validation of specific sentinel enviroity. (CEHR) vement, and intralaboratory validation of sentinel environmential methods for reproductive toxicity assessment to PE in integrated toxicity hazard assessment package. (CEHR)	ronmental toxicity hazard assessmental toxici	t methods for
Total	635	and field vandation and inclusion in a	in integrated toxicity nazard assessment package. (CERK)		
Project BS04	1		Page 36 of 74 Pages	Exhibit R-2A (PE 06	601102A)

		ARMY RDT&E BUD	GET ITE	M JUS	ΓIFICA	ΓΙΟΝ (R-	2A Exh	ibit)		DATE Fe	bruary 19	999
	BUDGET ACTIVITY 1 - Basic Research					IUMBER AND 01102A		Research	n Science	PROJECT BS13		
	(COST /In Thougands)				FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS13 Science	3S13 Science Base/Medical Research infectious Disease 8341 9090			8997	9206	9425	11890	12642	13373	Continuing	Continuing	
to their potent	ial imp ns and e	and Justification: This project act on military operations. Developments act on military operations. Developments: Cloned, expressed, purified a "rational" approach to vaccin necessary studies to guide fut for inducing P. vivax gameto. Completed sequencing of Pla Internet web sites at all major possible more rapid and spectal falciparum genetic material for purification of chromosomes. Identified five classes of fund program at Walter Reed Arm drugs for the treatment and partemisinin), a process necessimalaria parasites worldwide. Completed epitope mapping of epitopes among different Shige enteric pathogens, necessary. Constructed primers for PCR ETEC in over 500 clinical sa support of studies of vaccine. Identified specific Campyloba glycosylation relevant to desi in Campylobacter species and	nd assayed for edesign. Do the design. Do the design of th	unctional acemonstrated developmento, which are ciparum charters to facilify to accines an anternational ection of DNA ans as potent f Research (*Leishmania* blishing humber on al Shigella*. Discovereing subjects in of pathogoding sample as (flagellin) nogenic, pro-	tivity of a complete the roles of and testing necessary romosome rotate open and drugs ag Malaria Geometric and targets for WRAIR). It is is interested and charant numan cleanic enterotes from U.S. and toxins tective candidate of the content of t	randidate many from the control of t	laria vaccine lls, CD4+ T capacity for for studying collaboration omic data by c structural a ct by devisin drugs using the ew function olites of new Conducted s id antigens (A and polym of candidate coli (ETEC) ing in Thaila distending to es. Improve	e (recombinated la cells, IL-12 growing Place and surveillance and protein the candidate a surveillance and, that is not said in the candidate a surveillance and, that is not said and, that is not said methods a surveil and imped methods and methods are considered and the candidate	nt EBA-175 and NK cell asmodium vi human chal stitute for Ge ators. Genet al proteins of s and method d structure-b at may serve ntimalarial d for emerging s, necessary reaction (PC ceines. al stool samp ecessary for proved under	protein) whis in protective wax in cultural lenge studies enomics Research for identification and a second for identification and in the continuity of the continuing restanding of	ch may be use immunity e and devise is. earch. Establedata will massum. Provided ication and larial drug deal target for icacid, arteenace patterns for identification isk assessment of the surveillation isk assessment.	sed in a in mice, d methods dished ke d all P. esign inhibitor ether and in immune tion of ence for ent and for ional
Project BS13					Page 37 o	f 74 Pages			Exhibi	t R-2A (PE	0601102A)	

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **BS13** FY 1998 Accomplishments: (continued) 246 Incorporated primers which amplify the "rfc" gene which encodes O-antigen polymerases of *Shigella* species into a multiplex PCR with the Campylobacter jejuni "ceuE" gene, necessary for development of a sensitive, specific forward deployable diagnostic device capable of detecting multiple infectious pathogens of military interest. Prepared both recombinant and native hantavirus nucleocapsid antigens for use in diagnostic assays for hantavirus infection. Devised techniques for engineering specific mutations in dengue virus, necessary for producing candidate, live-attenuated dengue vaccines. Devised quantitative reverse transcriptase (RT)-PCR assay in order to characterize Th1 and Th2 (helper T cell 1 and 2) responses to vaccination, necessary for comparing and down-selecting dengue candidate vaccines. Constructed type-specific fusion proteins using recombinant dengue antigens for improvement of capability of field diagnosis of dengue. Demonstrated very low in incidence of transmission of live-dengue vaccine to mosquitoes, necessary for evaluation of public safety of candidate, live-attenuated dengue vaccines. Prepared candidate naked DNA vaccine expressing the M segment of Seoul Hantavirus (Korean hemorrhagic fever virus) for comparison and down selection with other candidate vaccines. Studied dynamics of molecular change and viral replication of Seoul Hantavirus as a means to understand persistence of Hantavirus in rats, necessary to provide insight into transmission prevention. Devised an assay of Hantaan viral polymerase function, necessary for design and assessment of antiviral drugs against Hantaan virus. Identified four new classes of compounds with potential for development as effective agents for treatment of hemorrhagic fever viruses. Conducted surveillance for Chikungunya virus and Hantavirus outbreaks in Indonesia, necessary to define potential sites for tests of candidate vaccines. Conducted serosurveys for Murray Valley virus and Ross River virus among equine populations in Indonesia and documented significant prevalence among three different stable populations, necessary studies for determination of potential risk to deployed personnel in the Australasian region. Conducted serosurveys of Hantavirus infections among rodent and human populations in the Amazon river basin, necessary for risk assessment to deployed personnel. Devised a test for hepatitis E for use in field studies and vaccine trials. Identified rats in Nepal as a potential reservoir of hepatitis E virus (HEV), necessary for understanding and potentially preventing transmission of HEV to human hosts. Genetically characterized African strains of HEV and demonstrated sufficient genetic similarity between African and Asian strains of HEV such that a vaccine against Asian strains will likely be effective at preventing infections with African strains. Conducted risk assessment for HEV in rural Thailand and discovered that 3% of acute hepatitis is attributable to HEV. Identified and characterized multiple antigens of *Orientia tsutsugamushi* for potential use in diagnostic tests for drug-resistant scrub typhus. Identified multiple primers for cloning genes of O. tsutsugamushi, potentially useful as markers for studying the pathogenesis of scrub typhus. Constructed primers for evaluation of PCR methods for diagnosis of Leishmania infection, necessary for epidemiological and clinical study support and for future field studies of candidate vaccines. Demonstrated induction of bactericidal antibodies by two candidate vaccines against an epitope common to most Group B meningococcal strains, important to selecting final design of candidate vaccines for prevention of disease caused by Group B meningococcus. Exhibit R-2A (PE 0601102A) Project BS13 Page 38 of 74 Pages

		ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	February 1999
виддет ас 1 - Basi		pe number and title arch 0601102A Defense Research Science	PROJECT BS13
FY 1998	Accompli	shments: (continued)	
•	704	Conducted surveillance studies of febrile illness, respiratory disease, encephalitis, diarrhea, hemorrhagic fever an America and Africa to identify potential new infectious disease risks for deployed forces. Designed a pilot influence Pacific Rim. Among 400 cases of encephalitis in Ho Chi Minh City, Vietnam, identified Japanese encephalitis as among children. Identified epidemic typhus as a significant etiology (28 of 78 cases) of febrile illness in an outbrever as a significant cause (5 of 35 cases) of febrile illness in an outbreak in Peru. Studied over 2,900 patients we febrile illnesses in urban communities in the Amazon rain forest. No hemorrhagic or encephalitic syndromes were observed. De Norwalk virus among shipboard populations in the U.S. Navy (attack rate of 40% aboard an aircraft carrier). De for <i>O. tsutsugamushi</i> (scrub typhus) with pre- and post-deployment screening of deployed U.S. personnel in Vietr transmission of dengue. Demonstrated clinical (6 cases) and subclinical infection with Ross River virus and Bermah Forest virus creening among U.S. personnel during "Tandem Thrust" deployment. Established forward laboratory capabilities Australasian viruses of potential military relevance. Designed and synthesized 18 new compounds as potential candidates for replacement of DEET, the current stand xanthurenic acid as the chemical factor that stimulates malaria gametocyte exflagellation prior to zygote formatic	nza surveillance project for the sthe major etiology, especially reak in Peru. Identified Mayaro ho presented for evaluation of monstrated epidemic potential of monstrated an attack rate of 3.2% nam. Showed no significant rus using pre- and post-deployment es in Indonesia for diagnosis of ard for insect repellency. Identifie
	145	prevention of malaria transmission. Identified PCR primers for potential use in diagnostic tests of rickettsial dise Devised species differentiating DNA markers in mosquito vectors that may be useful in developing strategies for	ases, especially scrub typhus. control of malaria vectors.
•	145	Explored mechanisms of synthesis of bacterial, viral and parasitic antigens, necessary for process and manufactur production of vaccine and other biologics for research and field use.	ring development for pilot
Total	8341		
FY 1999 P	lanned P	rogram:	
•	1799	Assess functional antibody responses to the <i>P. falciparum</i> MSP-1 protein and design modified MSP-1 proteins the Characterize memory T cell immune responses to leading vaccine antigen candidates. Incorporate initial data ob into vaccine development efforts.	
•	1249	Begin sequencing of <i>P. falciparum</i> Chromosome 14. Design bioinformatics capability for rapidly identifying the data for entry into malaria vaccine and targeted drug programs.	best gene targets from the sequence
•	880	Identify at least five different target proteins for structure-based drug design of novel antimalaria drugs. Establish create large libraries of compounds) program for discovery of new functional inhibitor drugs. Exploit emerging a chip-based DNA microarrays, to discover methods and technologies to improve detection of drug-resistant malariant malariant drugs.	advanced technologies, including ia.
•	548	Determine best approach for a <i>Shigella dysenteriae</i> vaccine. Identify monoclonal antibodies to <i>Shigella</i> virulence dipstick immunodiagnostic assay for <i>Shigella</i> in dysenteric stools.	e proteins that could be used in a
Project BS	13	Page 39 of 74 Pages Exhib	it R-2A (PE 0601102A)

		ARMY RDT&E BUDGET ITEM JUSTIFI	CATION (R-2A Exhibit)	DATE Feb	ruary 1999
BUDGET A	CTIVITY		PE NUMBER AND TITLE		PROJECT
1 - Bas	ic Rese	arch	0601102A Defense Res	earch Sciences	BS13
FY 1999	Planned I	rogram: (continued)			
•	277	Study uptake and processing of microspheres in animals to vaccine. Explore expression vectors for four defined ETEC Explore an improved animal model for ETEC diarrhea.			
•	304	Devise a system to reduce the effect of virulence genes, need Identify bacterial and human factors associated with post-i			cter vaccines.
•	224	Select specimen-processing procedures that yield optimal if luid to support a hand-held system for far-forward diagnos pathogens directly from stool specimens.	solation of nucleic acids from medica	al specimens of whole blood, urin	
•	808	Identify and characterize potential components of future li- characterize potential components of future dengue diagno			lentify and
•	300	Construct primate monoclonal antibodies for use in immur Identify common threads in the pathogenesis of the causes	otherapy for Crimean Congo hemor	rhagic fever (CCHF) and Lassa v	virus infections.
•	142	Genetically characterize up to 20 isolates of HEV from arc			
•	222	Confirm presence of drug resistance in <i>O. tsutsugamushi</i> , to construct and define mechanisms of antibiotic resistance		enes from antibiotic-resistant scru	ub typhus organisms
•	262	Identify the role and effects of cytokines in Leishmania infe			
•	122	Conduct molecular studies of optimized and multivalent vadesigned to protect recruits against bacterial meningitis.	-	-	-
•	470	Identify emerging pathogens that could put deployed soldifever and other conditions.	_	-	_
•	713	Synthesize by computer modified versions of the most efficient carrying Leishmania and mosquitoes carrying dengue viru	s.		ction of insect vectors
•	295	Explore novel and improved methods of vaccine production	•	•	
•	322	Identify and characterize potential components of future as hantavirus vaccines in mice. Devise delivery system for al SE Asia.			
•	153	Small Business Innovation Research/Small Business Techn	nology Transfer (SBIR/STTR) Progra	ams	
Total	9090		<i>(</i> , , , , , , , , , , , , , , , , , , ,		
FY 2000 I	Planned Pi	ogram:			
Project B	S13	Pag	e 40 of 74 Pages	Exhibit R-2A (PE 0	601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **BS13** 1367 Identify and characterize further the mechanisms of protective immunity and targets of protective immune responses against *P. falciparum* and P. vivax. Discover additional P. falciparum and P. vivax vaccine immunogens. Devise assays that measure markers of protective immunity. FY 2000 Planned Program: (continued) Devise strategies for rapidly exploiting the genomic sequence for vaccine and drug development. Prepare P. vivax genomic DNA for sequencing. Identify candidate antimalarial drugs using chemical synthesis or by isolation from natural products. Identify techniques for the cultivation and drug sensitivity testing of P. vivax malaria. Employ molecular modeling to design antimalarial drugs. Identify, clone and express target proteins for structure-based drug design and determine modes of action and resistance of antimalarial drugs. Create a deployable field test to assay drug sensitivity patterns in malaria based on enzymatic, colorimetric, probe or micro-array technologies. Conduct target-based and whole organism screening systems for assaying activity or determining cytotoxicity candidate drugs. Conduct assays to discover synergistic drug combinations or resistance modulator drugs. Create computer systems to analyze, merge and compare physicochemical and biological data. Maintain a drug repository to include acquisition, storage and distribution. Prepare drug delivery systems of compounds under Good Laboratory Practice/Good Manufacturing Practice (GLP/GMP) compliance. Conduct a surveillance program for drug-sensitivity patterns of malaria from diverse geographic regions. Evaluate immune responses generated by candidate Shigella vaccines with the goal of establishing parameters of protection. Modify candidate live vaccines to reduce reactogenicity and/or excretion while retaining efficacy, allow rapid identification of excreted organisms, and enhance efficacy. Devise reagents for rapid and economical diagnostic techniques for use in Shigella vaccine trials. Construct polyvalent vaccines using live Shigella carrier(s) or subcellular protein carrier(s). Annotate Shigella plasmid DNA sequences to identify virulence determinants. 399 Characterize protective immune responses in humans and animal models. Characterize the predominant ETEC strains and associated virulence factors that occur in likely areas of military operations. Select candidate immunogens for inclusion in vaccine candidates. Identify and characterize the full range of bacterial systems, antigens and toxins important in disease pathogenesis and protective immunity to provide the basis for development of vaccine candidates. Identify bacterial factors involved in inflammatory cytokine induction for potential development as vaccine antigens. Obtain knowledge of protein glycosylation in campylobacter and its importance in pathogenesis and modulation of the immune response, necessary for design of vaccine antigens. Define the role of cytolethal-distending toxin in disease and immunity. Further study of non-sialylated mutants as possible vaccine candidates to potentially mitigate safety issues such as vaccine-associated Guillain-Barre syndrome. Construct live-attenuated carrier vaccine candidates expressing campylobacter antigens. Construct combined vaccines expressing Campylobacter, Shigella and ETEC antigens. Utilize available genomic sequencing to identify and investigate important areas of virulence gene homology with other enteric pathogens and explore their role in campylobacteriosis. Study target sequences that appear to be unique to Campylobacter. Investigate metabolic pathways identified in the sequencing that may be exploited for the development of auxotrophic liveattenuated strains. Devise specimen-processing methods that allow the purification of target nucleic acids in less than 30 minutes. Construct PCR primers and probes for diagnosis of malaria, enteric diseases, dengue viruses and the hemorrhagic fever viruses. Identify predictors of long-term immunity (and safety) to establish basis for down-selection among competing dengue vaccine designs. Exhibit R-2A (PE 0601102A) Project BS13 Page 41 of 74 Pages

		RMY RDT&E BUDGET ITEM JUS	STIFICATION (R-2A Exhi	oit) DATE Febr	ruary 1999
BUDGET ACT	TIVITY		PE NUMBER AND TITLE	•	PROJECT
1 - Basid	c Rese	ırch	0601102A Defense R	esearch Sciences	BS13
•	309	Assess mechanisms of pathogenesis to include vira models of VHF and encephalitis. Construct primat primates. Improve capability to rapidly identify the outbreaks to validate assays and obtain fresh field s	e monoclonal antibodies for evaluation ese agents in the field and provide definition	of protective efficacy in animal model itive confirmation in reference labs. In	s including
FY 2000 P	Planned F	rogram: (continued)			
•	97	Establish level of antibody that prevents HEV disease Continue epidemiological studies of HEV and virus among humans in Latin America using virus detect isolates. Characterize determinants and pathophysis	s phylogenetic analysis in Asia and Afriction as basis for diagnosis. Characterize	ca. Sustain or refute presence of hepa	titis E disease
•	268	Establish the degree of immunologic heterogeneity protection against heterologous challenge in mice. isolates for use in the development of a polyvalent DNA) and evaluate their protective efficacy in mice	among available <i>Orientia</i> isolates. Def Clone and sequence appropriate strain- scrub typhus vaccine. Prepare one or m	specific antigens from appropriate nor	n-crossprotective
•	307	Analyze the human antibody response to specific secomposition, lipid concentration, pH, and lyophiliz formulation. Identify three additional vaccine straik nock out sialic acid production and if necessary er	elected components of the OMP-dLOS vation on the structure and immunogenic in candidates with different (most preval	ity of the proteoliposome OMP-dLOS	vaccine
•	821	Conduct risk assessment and identification of vector identify vectors and evaluate their local importance DoD research laboratory. Evaluate the threat of tic will outperform DEET in durability, effectiveness, distribution of dengue vectors. Prepare handbook a and vectors, and most appropriate control and survein vectors.	ors other than dengue vectors. Design in the to disease transmission. Establish a state of the thick and chigger-borne diseases to the U.S and user acceptability. Begin basic research accompanying software for identific	andard insecticide resistance and susce military. Identify and test new repel arch on new devices for evaluating bi- ation of dengue vectors, evaluation of	eptibility test at each lent candidates that ting rate and dengue in humans
•	329	Devise processes for manufacture of at least 10 nev	w vaccine lots under current Good Manu	facturing Practices (cGMP) compliance	ce.
•	381	Assess antibody and cell-mediated immune responsion nonhuman primate and human infection with hanta	ses to candidate hantavirus vaccines in r	nice. Characterize and evaluate correl	lates of immunity in
Total	8997				
FY 2001 Pla	anned Pr	ogram:			
•	1095	Begin systematic screening of the genomic sequence candidate vaccine antigens.	ces generated through the Plasmodium s	equencing effort to identify additional	P. falciparum
Project BS1	13		Page 42 of 74 Pages	Exhibit R-2A (PE 06	601102A)

		RMY RDT&E BUDGET ITEM JU	STIFICATION (R-2A Exhil	oit) DATE F	ebruary 1999
BUDGET AG	CTIVITY		PE NUMBER AND TITLE	-	PROJECT
1 - Basi	ic Rese	ırch	0601102A Defense R	Research Sciences	BS13
•	1538	Complete and annotate the genomic sequence of <i>I</i>		•	
•	571	Determine unique <i>P. falciparum</i> gene targets that populations for field testing a drug for treatment of	of multidrug-resistant malaria.	ssay to detect drug-resistant paras	ites. Identify potential
•	464	Identify potential components of a combined poly	<u> </u>		
•	332	Identify the best ETEC candidate components for	inclusion in a combined enteric vaccine.		
FY 2001	Planned I	rogram: (continued)			
•		Identify components of candidate Campylobacter components of a combined enteric vaccine.	vaccines and vaccine approaches that wo	uld be compatible with the Shigell	la and ETEC
•	315	Identify nucleic acid primers and probes for Shige			agnostic platform.
•	791	Identify T-cell responses to dengue infection to mo			
•	409	Identify a primate model for viral hemorrhagic few	ver that does not require biosafety level 4	(BL-4) containment.	
•	83	Perform surveillance and epidemiology studies to			
•	421	Define the range of natural immunologic heteroge appropriate non-crossprotective isolates for use in candidates (e.g., recombinant, DNA) and evaluate	the development of a polyvalent scrub type	phus vaccine. Prepare one or mor	
•	257	Clone, express and characterize conserved antiger	as that are potential components of a mult	tivalent vaccine against Group B /	V. meningitidis.
•	1106	Complete a risk assessment of chigger and tick-bo resistance.	rne diseases. Complete establishment of	a system for worldwide surveillan	ace of insecticide
•	878	Devise processes for manufacture of at least 10 ne	w vaccine lots under cGMP compliance.		
•	572	Characterize and evaluate correlates of immunity in South America and SE Asia.	in nonhuman primate and human infection	on with hantavirus. Conduct surv	eillance for hantaviruse
Total	9206				
Project BS	S13		Page 43 of 74 Pages	Exhibit R-2A (Pl	E 0601102A)

Item 2

	ARMY RDT&E BU	DGET IT	EM JUS				oit)		DATE Fe	bruary 19	999
BUDGET ACTIVITY 1 - Basic Res	1 - Basic Research				PE NUMBER AND TITLE 0601102A Defense Research Sciences					PROJECT BS14	
	COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS14 Science Base	BS14 Science Base/Combat Casualty Care Research 3704 3664		3972	4056	4143	4701	5360	5640	Continuing	Continuin	
related topic areas to development of trans	on and Justification: This project for exploratory techniques and tuma treatment and surgical process, and provide military medical	he experimer edures to ext	ntal models i end the time	necessary to of death du	support in-due to bleeding	lepth trauma g following t	research stu rauma injur	idies. This r y, minimize	esearch is th	e basis for th	ne
200 1556 374 750 200 200 200 224 Total 3704	Evaluated feasibility of med Continued microbiological s Examined molecular mechan Evaluated small volume resu Measured cytokine gene acti Evaluated antimicrobial mod Established human bronchia	ical decision urveillance on hisms that conscitation fluit vation in tiss dalities to pre	assist algori of burn victir ntribute to o dds as a thera ues after here event and tre	thms to enhans to aid in a ngoing cent apy for mass morrhagic shat burn-asso	ance first residentifying, and nervous sive pre-hosphock to identicated choice	sponder capa tracking, and system dama pital hemorrh tify possible dritis.	bilities in the reducing in ge after brain age.	e diagnosis a fections. in trauma. targets.	and treatmen	t of casualtion	es.
FY 1999 Planned 482 200 625 400 535 32 285 183 849	Research to extend the liquid Investigate the efficacy of a Evaluate pharmaceutical trea Investigate an anti-caries vac Investigate microarray gene Establish cell culture system occurs after smoke inhalatio Investigate methods for the of Verify the sensitivity of non Research into fundamental a	hemostatic dratments designeeine to reduce analysis method to test antiseen. diagnosis and invasive sen spects of sev	ressing designed to counce dental cashods to assessense DNA did repair of exsors designeere hemorrh	gned to stand ter central n sualties far-f ss cytokine of rected again attremity injued to monitor age to deter	ch massive b ervous syste forward. contribution ast bronchial tries including r physiologic mine require	leeding in commingury after to secondary epithelial managers bone, blood cal parameter ements for ag	ombat casual er trauma an tissue dama ucus genes t d vessels, an es for the dia gressive res	Ities. d to minimizage that occur o block the land skin. ugnosis and t	urs after traus	ma. on of mucus	_
Project BS14	Zimii Zuomess imovation i	1000ai 011/ 01110	LI Dusiness	Page 44 of			105141110	Exhib	oit R-2 (PE (0601102A)	

		ARMY RDT&E BUDGET ITEM JUS	TIFICATION (R-2A Exh	ibit) DATE F	DATE February 1999	
BUDGET AG	CTIVITY ic Rese	arch	PE NUMBER AND TITLE 0601102A Defense	Posoarch Scioncos	PROJECT BS14	
Total	3664		0001102A Deletise	Nesearch Sciences	B314	
FY 2000 I	Planned P	e				
	400 844	Continue refinement of an anti-caries vaccine to redu Investigations to determine the degree of resuscitatio		2000		
	414	Research into the diagnosis and treatment of blast, be				
	200	Investigate methods to detect pneumothoraces in cast				
	200	Investigate receptor-specific analgesia and pain relief				
	40	Screen antisense DNA against mucin genes for abilit	• 1		n.	
	599	Continue evaluating pharmaceutical treatments to rec				
	774	Evaluate in vivo models to assess the efficacy of phar resuscitation from severe hemorrhage.	macologic therapies designed to redu	ice or block ischemia-reperfusion i	njury that occurs after	
	501	Compare efficacy of competing methods that are used	d to prepare plasma products with en	hanced shelf lives.		
Total	3972					
FY 2001 I	Planned P	ogram:				
	400	Screen anti-caries vaccines in appropriate test models				
•	850	Continue research into optimal resuscitation protocol				
•	422	Continue research into the diagnosis and treatment o				
•	200	Compare computerized algorithms that integrate sens				
•	200	Continue investigations into receptor-specific analger				
•	100	Test antisense DNA directed against mucin genes for			tissue.	
•	600	Continue evaluating pharmaceutical treatments to co				
•	784	Continue to evaluate in vivo models to assess efficacy	y of pharmacologic therapies directed	d against ischemia-reperfusion injur	ry that occurs after	
_	500	resuscitation from severe hemorrhage. Screen second generation plasma products that incorp	porata improvomenta in atability and	waight in animal models to access	safaty and officery	
• Total	4056	screen second generation piasma products that incorp	orate improvements in stability and	weight in animal models to assess	saicty and efficacy.	
Total	4030					
Project BS	S14		Page 45 of 74 Pages	Exhibit R-2A (P	E 0601102A)	

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit) Politication (R-2A Exhibit)										
BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences							PROJECT BS15			
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BS15 Science Base/Army Operational Medicine Research	4990	9341	5378	5508	5640	7351	8286	8572	Continuing	Continuin
Mission Description and Justification: The scientific and technical objectives for this project focus on physiological and psychological factors limiting soldier effectiveness, and on the characterization of health hazards generated by military systems and resulting from military operations. Research is conducted on militarily relevant aspects of environmental physiology and the neurobehavioral aspects of stress. The hazards of exposure to several classes of non-ionizing radiation, directed energy, blast, jolt, vibration, noise, and toxic industrial chemicals as environmental contaminants are also investigated under this project. Specific tasks include delineating injury and effect thresholds, mechanisms, and sites of action. Emphasis is on protection, sustainment, and enhancement of the physiological and psychological capabilities of military personnel under combat operations in all environments. The six main thrust areas include neuromodulation of stress and cognition, metabolic regulation, control of regional blood flow, oxidative stress interventions, tissue remodeling/plasticity, and biomechanical/biodynamic mechanisms of injury. A portion of this research supports the Science Research Objective (SRO) on "Enhancing Soldier Performance."										

- 908 Discovered suppression of immunological responses to vaccination (Hep A vaccine) in Army Ranger students subjected to multiple stressors in training.
- Discovered that high fat diets worsen the effect of stress on immune function parameters (lymphocyte proliferation) in a rodent model.
- Demonstrated that exposure to extreme heat stress increases intracellular levels of calcium in isolated human endothelial cells via influx from the external medium.
- 250 Demonstrated that blood platelets in soldiers following 2 hours of cold exposure have a decreased sensitivity to activation by adenosine diphosphate.
- Investigated temperature pill technology to quantify body heat balance during body heating and cooling.
- Determined relationship of melatonin to prolactin and gonadotropins and confirmed absence of adverse effects on the female reproductive system. 242
- Identified candidate suite of biomarkers for assessing redox status and evaluated role of oxidative stress on pathogenesis of inhalation of particulates.
- Proposed a preliminary model to predict incapacitation resulting from toxic combustion gases in enclosed space for use in crew casualty/soldier 200 survivability assessments.
- 150 Confirmed hypothesis that a brain neurotransmitter precursor, tyrosine, could reduce stress and improve mental performance in female soldiers in stressful conditions (e.g., cold and hypoxia).
- 225 Discovered that sleep deprivation impairs performance by deactivating brain areas mediating alertness, attention, and complex task performance.
- Characterized the role of thickness of skin, clothing, and soft and hard body armor in enhancing or reducing injury to the thorax.
- Determined optimal biomechanical properties of backpack loads (e.g., center of mass and pressure point studies) necessary for optimal design of the Land Warrior and other load carriage systems.

Exhibit R-2A (PE 0601102A) Project BS15 Page 46 of 74 Pages

		ARMY RDT&E BUDGET ITEM JUSTIFI	CATION (R-2A Exhibit)	DATE February 1999
BUDGET A 1 - Bas	CTIVITY Sic Rese	PROJECT BS15		
FY 1998	3 Accompli	hments: (continued)		
•	375	Determined fatigue-based operational criteria for head-sup based helmet weight design criteria.	ported mass in female aviators and developed biod	lynamic simulation to confirm injury-
•	200	Overcame a technological barrier to visual performance tea	sting with invention of a new test, the Small Letter	Contrast Test, with broad applications.
•	350	Demonstrated adaptive ocular response mechanisms that u lesions.	nderlie the natural recovery of visual acuity after r	elatively mild laser-induced foveal
•	360	Determined mechanism of near-infrared laser-induced retine weapons simulators.	nal injury that will support development of soldier	safety criteria for the MILES 2000
Total	4990	-		
FY 1999	Planned P	rogram:		
•	850	Explore effects of an amino acid dietary supplement on muin women (SRO).	sscle metabolism and strength following a protract	ed resistance exercise training program
•	400	Characterize energy substrate metabolism and performance (SRO).	benefits from consumption of a solid carbohydra	te supplement in intensive field training
•	760	Identify urinary markers for stress fracture and bone remove	leling in men and women undergoing recruit train	ing (SRO).
•	550	Evaluate the effects of significant hypothermia and rewarm hypothermia (SRO).	ning on vascular permeability and reticuloendothel	lial function in a rat model of human
•	441	Quantify the effects of marked hyperthermia on extravasat	on and reticuloendothelial function in a validated	rat model of human heat injury (SRO).
•	170	Evaluate and review vertebrate chemoreceptor oxygen sensing applications.	sing mechanisms, adaptation to altitude, and poten	tial for novel bioengineered oxygen
•	381	Explore use of nonmammalian vertebrate models and new	redox measures for evaluation of individual soldie	r susceptibility to oxidative stress.
•	350	Characterize psychoneuroendocrine stress responses in stre	essful special operations military training scenarios	s.
•	280	Characterize significant pulmonary, gastrointestinal and be	ain cellular, biochemical, and functional changes	after blunt trauma.
•	500	Identify acute retinal vascular and neuronal injury mechani	· · · · · · · · · · · · · · · · · · ·	· ·
•	486	Explore effects of treatment in cultured human cells to assi		vention and treatment.
•	225	Explore feasibility of EEG-based analysis to distinguish re-		
•	200	Validate newly selected tests of visual performance by cor Small Letter Contrast Test, and the color acuity test.	·	
•	3549	Conduct Congressionally mandated program of nutrition readequacy of operational rations.	search support including metabolic laboratory stu-	dies and field assessments of the
•	199	Small Business Innovation Research/Small Business Technology	ology Transfer (SBIR/STTR) Programs	
Project B	S15	Pag	e 47 of 74 Pages E	exhibit R-2A (PE 0601102A)

		ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhib	oit) DATE Febru	ary 1999
BUDGET AC	CTIVITY	PE NUMBER AND TITLE		PROJECT
1 - Basi	ic Rese	arch 0601102A Defense R	esearch Sciences	BS15
Total	9341	•		
FY 2000 F	Planned P	rogram:		
•	869	Define energy requirements of men and women in various categories of jobs on Navy ships	and during Army field training.	
•	602	Determine the ability of vitamin/anti-oxidant supplements to prevent or improve recovery full during sustained operations (SRO).	rom over-use muscle injury or preserve l	lean body mass
•	650	Identify biochemical mechanisms and functional consequences of overtraining in soldiers stress (SRO).	with prolonged physical exertion and oth	her operational
•	500	Investigate mechanisms of heat acclimation strategies to optimize thermoregulation and tiss		
•	450	Investigate the mechanisms of various interventions (hypertonic saline/dextran and flunariz model of human hypothermia (SRO).	zine) to reduce hypothermia and rewarm	ning injury in a ra
•	600	Determine noninvasive neuroendocrine markers of mental performance (marksmanship, se operationally stressful environment.	nsory processing, attention and vigilanc	e) in an
•	225	Identify predictors of operational task performance with sleep deficit based on the relative of human sleep dose study (SRO).	contribution of a learning component, us	sing data from
•	600	Explore new oxidative stress assessment technologies for use in hazard sensors for environmental explorement and the stress assessment technologies for use in hazard sensors for environmental exploremental explor	mental and medical surveillance.	
•	500	Explore adaptive strategies of humans to laser exposure for inclusion in laser battlefield mo	dels and a virtual reality training system	n for soldiers.
•	382	Explore novel combination strategies (early and late phase) for treatment of laser-induced r	etinal injury inherent to battlefield laser	·S.
Total	5378			
FY 2001 F	Planned P	rogram:		
•	860	Explore approaches to reduce metabolic water requirements through thermoregulatory and		
•	300	Explore feasibility of modifying chemoreceptor oxygen sensing to simulate altitude to accel	• • • • • • • • • • • • • • • • • • • •	
•	710	Discover new biomedical code appropriate to modeling biophysical properties of human tiss structures through viscoelastic interfaces to fluid dynamics properties for use in injury scient	5 5	ls of rigid
•	760	Explore feasibility of nerve cells maintained on an electronic matrix to act as an electronic neurotoxic industrial and agricultural chemicals.	"canary" for detection and exposure mo	nitoring of
•	200	Investigate the effects of caffeine and/or ephedrine on metabolic rate and performance in co	old environments (SRO).	
•	250	Evaluate and quantify the efficacy of cytokine antagonists as prophylaxes/therapies to heat	injury/illness.	
•	200	Identify and quantify the role of cytokines and other cellular mediators in sleep deprivation		
•	257	Discover mechanisms of stress fracture and the relationship to bone mineral density to dete interventions to enhance bone mineral accretion (SRO).	rmine if stress fracture incidence can be	reduced through
Project BS	S15	Page 48 of 74 Pages	Exhibit R-2A (PE 060	1102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences **BS15** 1 - Basic Research 250 Explore relationship between sleep deprivation and performance using PET scan brain imaging technologies (SRO). Assess potential therapeutics against blast-induced neuronal damage in animal models. Investigate pharmacological intervention strategies to enhance cognitive and psychomotor performance in an operationally stressful environment. **FY 2001 Planned Program: (continued)** Explore novel combination strategies (early and late phase) for treatment of laser-induced retinal injury inherent to battlefield lasers. Total 5508 Exhibit R-2A (PE 0601102A) Project BS15 Page 49 of 74 Pages

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DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **BS17** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete BS17 Molecular Biology/Military HIV Research 412 397 435 441 448 485 648 667 Continuing Continuing Mission Description and Justification: This project provides for basic research for early diagnosis and identification of technologies to design prevention and treatment of HIV. The present emphasis is on identification and comparison of HIV strains from many geographical locations, characterization of etiologic agents and definition of tests for epidemiological surveys to design a vaccine to prevent disease. Current policy prohibits OCONUS assignments of antibody positive service members. A safe and effective vaccine for prevention of infection and intervention will permit all service members to become worldwide deployable. FY 1998 Accomplishments: 412 Demonstrated induction of neutralizing antibody against heterologous viral isolates and protection from challenge with heterologous viral isolates of HIV in rhesus macaque monkeys using a candidate vaccine consisting of oligomeric glycoprotein 140, administered in high and low dosages. Continued refinement of multimeric as a human immunogen by performing studies to stabilize and prepare the immunogen for human use. Conducted surveillance of HIV among commercial sex-workers (CSW) in Peru, prevalence approximately 1.3%. Conducted genotyping of 169 clinical HIV isolates. Detected first non-subtype B HIV in Peru, further demonstrating the widespread appearance of multiple genotypes, an important consideration in vaccine development and fielding and, perhaps, for prevention among US forces. Completed the Shipboard Sexual Risk Survey of US military service members deployed to South America. Demonstrated frequent (37%) sexual contact by service members but also showed high frequency of condom use (90%). 412 Total FY 1999 Planned Program: Identify complex protein (oligomeric) candidates for vaccines. Characterize the immune response against oligomeric protein vaccine candidates. Explore DNA vaccine candidates. 11 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs 397 Total **FY 2000 Planned Program:** 435 Evaluate the importance of HIV genotypes in predicting HIV immunotypes necessary for inclusion in an HIV vaccine. Define the correlates of immunity to HIV, necessary for vaccine design. Establish genetic and phenotypic correlates of drug resistance among HIV-1 clinical isolates, necessary for establishing drug treatment strategies for military dependents. Total 435

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Project BS17

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ARMY RDT&E BUDGET ITEM JUSTIFIC	DATE February 1999	
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601102A Defense Research Scie	PROJECT
FY 2001 Planned Program: • 441 Evaluate new methodologies for exploration of HIV drug re Total 441	sistance mechanisms outside the pol gene.	
Project BS17 Page	e 51 of 74 Pages Ex	khibit R-2A (PE 0601102A)

Item 2

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **BS19** FY1998 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** FY 1999 Cost to COST (In Thousands) Estimate Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete BS19 Telemedicine Soldier Status Research 465 615 624 635 614 677 709 Continuing Continuing

Mission Description and Justification: The purpose of this program is to perform research contributing to superior combat casualty care for troops through faster diagnosis and treatment while allowing on-site health care providers to consult with specialists worldwide. This work will focus on developing the means to determine soldier physiological status and aiding medical diagnosis and treatment. A significant thrust area will work to ascertain the sensors most relevant to determine change in soldier physiological status.

FY 1998 Accomplishments: Project not funded in FY 1998

FY 1999 Planned Program:

- 360 Conduct analysis and validation of requirements for telesurgical mentoring technology.
- 92 Conduct research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- 13 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 465

FY 2000 Planned Program:

- Develop the transmission and reception capability for the prototype high resolution digital stereoscopic video biomicroscope.
- 86 Investigate efficacy of various portable and hand-held medical imaging devices, including 3D ultrasound.
- 162 Conduct research on predictive diagnostics for computer-assisted critical care and medical decision support.
- 124 Conduct research in medical robots with improved control and functionality for telepresence surgery.
- 97 Continue research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- Explore technologies that enable prognostic critical care decision support and autonomous life support systems (e.g., sensor fusion algorithms).

Total 615

FY 2001 Planned Program:

- 215 Continue research on predictive diagnostics for computer-assisted critical care and medical decision support.
- 180 Continue research in medical robots with improved control and functionality for telepresence surgery.
- 120 Continue research in Web-based consultation for dermatology and other medical specialties (e.g., pathology, echo cardiography).
- Continue to explore technologies that enable prognostic critical care decision support and autonomous life support systems (e.g., sensor fusion algorithms).

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		DATE February 1999						
BUDGET ACTIVITY	PE NUMBER AND TITLE							
1 - Basic Research	0601102A Defense Research Sciences							
Total 624								

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ARMY RDT&E BUD	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)									
BUDGET ACTIVITY 1 - Basic Research		PE NUMBER AND TITLE 0601102A Defense Research Science				PROJECT AT22				
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate		FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AT22 Soil and Rock Mechanics	1798	1802	18	69 1898	1929	2197	2546	2619	Continuing	Continuing

Mission Description and Justification: Basic research in this project develops the fundamental knowledge base required by the Army in the field of civil engineering. Current emphasis is on: defining the constitutive behavior and penetration mechanics (including plastic deformation and microfracture mechanics) associated with projectile impact on complex geologic and structural materials; development of mathematical models needed for first principle analyses of explosive-induced ground shock and high-velocity projectile impact; development of analytic models and advanced construction materials for the design and construction of permanent or expedient operating surfaces both within CONUS and within a theater of operations; development of adaptive or responsive construction materials suitable for camouflage, concealment, and deception measures for fixed or semi-fixed assets; and determining and quantifying the non-linear, hysteretic response of deformable soils to transient loadings resulting from high-speed curvilinear vehicle maneuver. These technologies provide the basis for applied research to provide: analytical capabilities for mobility assessments; hardened battlefield positions, fixed facilities, and semi-fixed assets; multispectral camouflage, concealment, and deception for fixed facilities; and advanced vertical and horizontal construction materials in PE 0602784A, Project AT40.

FY 1998 Accomplishments:

1798

- 1798 Developed improved 3D projectile trajectory code that predicts turning during shallow impact and projectile damage .- Evaluated responsive materials and selected natural color combinations.
 - Evaluated models for predicting the durability and dynamic behavior of pavement materials.
 - Exploited aggregate soil theory to model vehicle plowing performance; conducted experiments in Army centrifuge to collect patterns of soil response to wheel loadings.

Total 1798

FY 1999 Planned Program:

• 1754 - C

- Complete first-principle code calculations simulating oblique-impact long-rod penetration tests against concrete targets.
 - Incorporate selected responsive/passive materials into/onto substrate host.
 - Complete analytical models for predicting traffic distribution, cohesive soil moisture response, and compaction behavior.
 - Develop analytic model describing influence of partial soil saturation on surface shear strength.
- 48 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1802

Project AT22 Page 53 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AT22 FY 2000 Planned Program:** 1869 - Incorporate projectile erosion algorithms into penetration prediction codes. - Determine appropriate combinations of responsive/passive composite materials for camouflage, cover, and deception (CCD) as a function of environment and facility. - Develop theoretical formulation for penetration of wheels into partially saturated soils during cross-country movement (2Q00-4Q00) - Verify constitutive models for asphalt pavement materials and implement constitutive models for granular materials into an advanced pavement system model. 1869 Total FY 2001 Planned Program: 1898 - Develop finite element interface algorithms for response of target joints and fractures to projectile penetration. - Develop experimental quantity of responsive/passive CCD material. - Model soil response to transient loading patterns of wheeled and tracked vehicles. - Evaluate pavement interface, load, dynamic response, and traffic distribution models. - Determine physics of fiber-soil interaction that facilitates increased soil stability. 1898 Total

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Project AT22

		ARMY RDT&E BU	JDGET ITE	M JUS	ΓΙΓΙCΑΤ	ION (R-	2A Exhi	bit)		DATE Fe	bruary 19	999
BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Science								es		PROJECT 4T23		
	C	OST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AT23 Bas	ic Research	/Military Construction	1427	1564	1579	1605	1630	1907	2209	2271	Continuing	Continuin
and utility	infrastruct lement 06	via Project Reliance) unique ure to achieve the infrastru 02784A, Projects AT41 and the control of the control	d AT45. This poeraction protocol	tion goals of roject has signs, common	the current gnificant dua	national milial-use application	itary strategy ation potenti	y. This proj ial.	ect supports	exploratory	developmen	t efforts in
Total	1427	Developed an understar structures.Continued development	nding of active n	nagnetostrict	ive tagging	of constructi						e
FY 1999 P	lanned Pi	ogram:										
• Total	1523 41 1564	 Develop collaborative e Characterize Electrical ' Continue 3-D response Develop concepts for m Small Business Innovat 	Time-Domain R analysis of steel agnetostrictive p	eflectometry buildings for patch structu	(ETDR) for r seismic saf ral health m	r evaluation ety. onitoring sys	of structural stems.	health of la		structures.		
FY 2000 P	lanned Pi	ogram:										
•	1579	 Fundamental understand Characterization of post Models for determining 	t-elastic respons	es of frame a	and shear wa	alls to tri-dire						
Total	1579	_		J	•							

		ARMY RDT&E BUDGET ITEM JUSTIFI	CATION (R-2A Exhibit)	DATE February 1999
BUDGET AC 1 - Basi		arch	PE NUMBER AND TITLE 0601102A Defense Research Science	PROJECT
FY 2001 F		 Develop theory for collaborative axiomatic designs. Develop and test models for force development in shape n Evaluate principles for infrastructure applications of functions. 	tionally gradient materials systems that are multiple f	function layerwise systems that can
Total	1605	perform multiple sensor/actuator functions over a finite dis	tance.	
Project A	Г23	Pag	e 56 of 74 Pages Exhi	bit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **AT24** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete AT24 Snow, Ice and Frozen Soil 1357 1157 1166 1184 1204 1410 1627 1673 Continuing Continuing

Mission Description and Justification: This project is the only focused DoD basic research program investigating the physical, chemical, and electrical properties of snow, ice, and frozen soil and characterization of dominant winter and cold regions processes impacting military materiel, operations, and facilities. It provides the knowledge base for exploratory development to support modeling and simulation and product improvements as well as leading to reduced life-cycle costs and increased readiness and operability in extreme cold, high altitude and seasonal winter conditions around the world. Products are directly input to PE 0602784A, Project AT42, as well as Navy and Air Force science and technology efforts, and form the basis for much civilian applied research in these areas. It provides the fundamental knowledge base for developing concepts and approaches to upgrade materiel and doctrine for more effective performance in these challenging conditions.

FY 1998 Accomplishments:

- 1357 Quantified the rapid and dynamic evolution of millimeter wave radar response in temperate snow conditions.
 - Parameterized role of snow cover in turbulent exchange of heat and moisture in boundary layer.
 - Quantified dominant acoustic propagation processes for mapping snow covered terrain.

Total 1357

FY 1999 Planned Program:

- 1126 Develop vectorized seismic wave propagation code for viscoelastic/porous media.
 - Develop computer model to analyze ice properties derived from satellite microwave footprints.
 - Develop procedures for mapping regional atmospheric icing.
- 31 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1157

FY 2000 Planned Program:

- 1166 Investigate small-scale heterogeneity for state-of-the-snow/ground modeling.
 - Analyze spatial variability of icing processes relevant to communications and air operations.
 - Determine efficiency of snow as a filter for chemical particulates.

Total 1166

Project AT24 Pages Exhibit R-2A (PE 0601102A)

		ARMY RDT&E BUDGET ITEM JUSTIFIC	CATION (R-2A Exhibit)	DATE February 1999
BUDGET AC	стіvіту ic Rese a	arch	PE NUMBER AND TITLE 0601102A Defense Research Science	PROJECT AT24
FY 2001 P				
•	1184	 Develop model for parameterizing turbulent energy exchar Develop statistical characterization of ice thickness releva Broaden understanding of snow friction processes relevant 	ant to winter operations.	
Total	1184	- broaden understanding or snow metion processes relevan	it to minuary operations.	
Project A	T24	p_{aa}	e 58 of 74 Pages Exhi	ibit R-2A (PE 0601102A)

Item 2

1	ARMY RDT&E BUD	GET ITE	M JUS	ΓΙFICΑΊ	TION (R-	2A Exhi	bit)		DATE Fe	bruary 19	999
BUDGET ACTIVITY 1 - Basic Rese		UMBER AND 101102A [es	PROJECT BT25						
C	COST (In Thousands) FY1998 Actual FY 1999 Estimate FY 1999 Estimate						FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BT25 Environmental F	BT25 Environmental Research - Corps of Engineers 4209 4135			4458	4530	4601	5042	5134	5343	Continuing	Continuin
clean up the Army's at non-industrial inst for rehabilitation of oproject will also example supports applied reserves a Broad FY 1998 Accomplish	Illution prevention areas. The focustaminated sites. In complia allations. The focus in conserved amaged lands, and fundamentation in the underlying requirement arch under PE 0602720A, Proj. Area Announcement requesting the contaminated fundamental biog. **CERL**) - Developed an integrated hillower of the continued experiments to incompleted dynamic visualistication. Continued experiments to incomplete distribution of the contaminated sites; to maintation to site assessment at the experiments of fundamental investigations of fundamental completed. (WES) • Investigating bio-geoche Cold Regions Research at Investigations of chemical contaminated sites.	ance and pollivation is on last of training the for complects AF25, I g work suppose the cohemical plants and restoration method the compliants and restoration in compliants and restorat	aution prevent and form and g and test act rehensive er 2048, and A corting in-hor processes af thannel evolution mechanicatalytic destrick icknowledge and prevent programs terization set of complex and for multiplesses at low/firing Laborate.	ntion, effort lecological etivity noise avironmenta 896. Sixty-use laborate fecting crypation model apport erosism and pathruction of nue needed to ent pollution and to contaminate contaminate reezing tempory – CRRE	s address known modeling, the as they might as they might as they might have been as an investion and lands away for election away for election and lands away for election away for electio	owledge gap he feasibility ht be applied and simulation (65%) of the cession. (U.S. gation and p cape process trochemical compounds. sical, chemi- stallations; to and ecolog Army Wate ractions on s er transport h quantified	s vital to ma of developm to reducing in products to e funds in this s. Army Con orediction too simulations reduction of (CERL) cal, and biological modeling rways Experiensor responses mechanisms	intaining connent and property adverse efformation and property are struction Englished by the structure and analyzed by the structure analyzed by the structure and analyzed by the structure analyzed by the structure and analyzed by the structure and analyzed by the structure and analyzed by the structure analyzed by the structure analyzed by the structure and analyzed by the struc	mpliance and appagation of sects on missistivironmental e used to suppagation of sects on missistivironmental e used to suppagaineering Resource of the section of the sect	d preventing resilient plar on activities issues. The port extrame esearch Laborates water. (CEI ean up Army emparisons a ed: ection. (WES tics in heteromulation. (U	pollution at species . This project ural pratories – RL) and S) geneous .S. Army

Item 2

Exhibit R-2A (PE 0601102A)

Project BT25

		ARMY RDT&E BUDGET ITEM JUST	IFICATION (R-2A Exhibit)	DATE Feb	ruary 1999
BUDGET AC	стіvітү ic Rese	arch	PE NUMBER AND TITLE 0601102A Defense Resea	•	PROJECT BT25
EV 1000	Aggampli	shments: (continued)			
Total	4209	 A program to investigate the fundamentals of elect (CRREL) to support enhanced discrimination and Programs to obtain the fundamental mechanisms o in sediment and of reduce and bind phenomena of A program to explore the phenomenology to support computational molecular thermodynamics. (CRRE 	identification of buried unexploded ordnar f biostabilzation of polycyclic aromatic hy explosives. (WES) ort the prediction of interfacial properties a	drocarbons (PAHs) under deni	trification conditions
FY 1999 P	Dlannad Di	ograme			
•	2076 1950	 Explore fundamentals of physical/chemical response of the composition of the com	simulating fate and transport of contamina ezeze-thaw environments and combined bio nochemical destruction of nitro containing military traffic and suitable for revegetatic pathways of major explosives types; e.g., ixed organics and metals with discontinuous	nts in groundwater. (WES) logical/geochemical/geophysic compounds. (CERL) on of training lands. (CERL) contaminants and media. (WES)	S)
•	109	- Small Business Innovation Research/Small Business		ms	
Total	4135				
FY 2000 P	Planned Pr 2180	 Continue investigation of photocatalytic destruction n Investigate interrelationship between changes in soil n 	nicrobial composition and plant succession	n dynamics. (CERL)	
•	1670	 Examine chemical and biological indicators to measure Develop experimental protocol to test bi-stable system Complete investigation of the fundamentals of electrons to support enhanced discrimination and identification of Continue description of the fundamental mechanisms conditions in sediment and "reduce-and-bind" phenomeral Continue the determination of adsorption and transform 	n using mathematical models. (CERL) magnetic induction spectroscopy (WES) a of buried unexploded ordnance. of biostabilzation of polycyclic aromatic h uena of explosives. (WES)	nd pan-spectral electromagneti ydrocarbons (PAHs) under der	
Project B7	T25		Page 60 of 74 Pages	Exhibit R-2A (PE 0	601102A)

		RMY RDT&E BUDGET ITEM JUSTIF	FICATION (R-2A Exhibit)	February 1999
BUDGET AC		arch	PE NUMBER AND TITLE 0601102A Defense Research Scien	PROJECT BT25
1 Buon	- 11000		COULTEST DOIGHOU NOOGGICH COICH	<u> </u>
FY 2000 F	Planned I	rogram: (continued)		
		- Develop a program to determine the basic processes need engineering. (WES)	cessary to optimize explosive degradation using molec	alar breeding and computer-aided
		- Develop a program to explore the basic principles of ne	eutron activation of munitions using high pressure xeno	on gamma ray detectors. (WES)
•	600	- Complete description of major biological degradation p		
		- Complete the determination of the phenomenology for	predicting NAPL interfacial properties and multiphase	soil hydraulic properties using
		computational molecular thermodynamics. (CRREL)		
 1	4470	- Develop a program to explore inversion techniques for	3D permafrost delineation. (CRREL)	
Total	4450			
FY 2001 Pl	anned Pr	ogram:		
•	2258	- Determine effects of soil microbial composition on dec	omposition, mineralization and nutrient availability, ar	d ultimately succession dynamics.
		(CERL)		
		- Develop methods to quantify biogeochemical indicators		oridation (CEDI)
	1922	Develop model for photo degradiation pathways for theComplete description of the fundamental mechanisms of		
•	1922	conditions in sediment and of "reduce and bind" phenon		(1 Aris) under demunication
		- Finalize the determination of adsorption and transforma		
		- Continue the determination of the basic processes neces engineering. (WES)	ssary to optimize explosive degradation using molecular	r breeding and computer-aided
		- Continue exploring the basic principles of neutron activ	vation of munitions using high pressure xenon gamma	ray detectors (WES)
		- Establish a program to explore the basic principles of se		
		remediation technologies. (WES)		•
		- Establish a program to investigate the basic factors affe	ecting ground penetrating radar (GPR) performance an	d their use in helping map terrain
		subsurface anomalies. (WES)		aladan dan faran iliyo latati a
		- Institute a study to understand the basics of visible and (WES)	near-infrared computed tomographic imaging spectrop	orarimetry for rapid UXO detection.
		- Conduct an investigation of the fundamental mechanism	ns of the stabilization and accumulation of heavy meta	ls by aquatic and terrestrial plants
		(WES)	and of the statement and accumulation of nearly mea	as of aquate and terresular plants.
•	350	- Complete the exploration of inversion techniques for 3I		
		- Establish a program for delineating biotic and abiotic \boldsymbol{m}	nechanisms for plant-induced attenuation of explosives	and organics. (CRREL)
Total	4530			
Project BT	25	n	age 61 of 74 Pages Ext	ibit R-2A (PE 0601102A)

ARMY RDT&E BU	DGETTIE	: IVI JUS I	IFICAI	ION (R-	ZA EXNI	DIT)		Fel	oruary 19	999
BUDGET ACTIVITY 1 - Basic Research				JMBER AND T 1102A [Research	Science	S		ROJECT \305
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A305 Automatic Target Recognition Research	1110	1019	1174	1207	1239	1377	1528	1585	Continuing	Continuir

Mission Description and Justification: This project focuses on the development of the fundamental underpinnings for aided and automatic target recognition capabilities for land warfare scenarios (primarily characterized by low depression angle, relatively short range and highly intense competing clutter backgrounds). Electro-optic/infrared (EO/IR) imaging systems utilizing advanced algorithms for interpreting and recognizing targets over extended battlefield operating conditions are essential for the warfighter. This project will develop fundamental capability to predict, explain and characterize target and background content. These efforts are aimed at evaluating the complexity and variability of target and clutter signatures and, ultimately, utilize that knowledge to conceptualize and design advanced Automatic Target Recognition (ATR) paradigms to enhance robustness and effectiveness. These ATR strategies include utilization of emerging sensor modalities such as spectral imaging and multi-sensor approaches. These research findings support several technology efforts including multi-domain smart sensors, third generation forward looking infrared (FLIR), advanced multi-function ladar, and advanced technology demonstrations (ATD) such as Multi-Function Staring Sensor Suite, Target Acquisition, and Joint Combat Identification. Research will also be conducted in the area of acoustic sensors, which can provide very low cost target detection capabilities.

FY 1998 Accomplishments:

1110 - Developed high resolution ladar signature prediction model

- Trained target recognizer using model results and tested on measured data
- Conducted principal components analysis on 8-12 micron imagery and developed clutter rejector based on that concept
- Created several hundred synthetically generated 8-12 micron infrared images to use in validation efforts

Total 1110

FY 1999 Planned Program:

• 1006 - Undertake thermal measurements in laboratory conditions on canonical shapes and compare with model predictions.

- Utilize existing target modeling capability to generate multiple instances and compare with measured signatures.
- Evaluate the phenomenology differences of co-registered 3-5 micron thermal images with 8-12 micron counterparts.
- Extend 8-12 micron IR ATR algorithms to the 3-5 regime.
- Develop innovative new approaches to acoustic beamforming and target identification.
- 13 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1019

Project A305 Page 62 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research A305 FY 2000 Planned Program: 1174 - Assess quality of thermal prediction for various scenarios (e.g., underground mines, etc.) - Isolate high and low false alarm rate images from IR data base and compute metrics of image complexity. - Conduct phenomenological studies of multi-spectral data to develop preferred operating bands for land warfare scenarios. - Develop a matching pursuits detection paradigm to accumulate evidence of primitive sub-elements of target emissions. - Conduct initial survey of hyperspectral data (both infrared and visible) and its applicability to land warfare missions. 1174 Total FY 2001 Planned Program: - Assess fidelity of thermal predictions for background data; improve model as indicated. - Correlate performance of one or more modern IR ATR algorithms with image complexity measures. - Based on measured phenomenon recommend preferred operating wavelengths for broadband mid and long wave thermal imagers. - Conduct phenomenological studies of hyperspectral data to assess minimum number of bands to achieve high discrimination performance at an affordable price for land warfare scenarios. 1207 Total Exhibit R-2A (PE 0601102A) Project A305 Page 63 of 74 Pages

ARMY RDT&E BUD	ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)										DATE February 1999		
					PE NUMBER AND TITLE 0601102A Defense Research Science				PROJECT A31B				
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	-		FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost		
A31B Infrared Optics Research	2202	1998	23	341	2421	2504	2893	3121	3259	Continuing	Continuing		

Mission Description and Justification: This project sustains the Army's theoretical and experimental research in night vision and electro-optic technologies. It generates new technology to obtain unprecedented awareness of the battlefield to continue to "own the night," notwithstanding increased foreign competition. To achieve these objectives, focal plane arrays (FPAs) with significantly improved performance for major platforms, laser radar (ladar) techniques that can utilize those FPAs, and low cost night vision aids that allow for wide distribution will be required. Therefore, research is focused on materials, devices and techniques required for the development of high performance smart dual color staring infrared focal plane arrays (IRFPAs), innovative ladar architectures, and uncooled IRFPAs with moderate performance. For the high performance IRFPAs mercury cadmium telluride (HgCdTe) detector arrays and quantum well infrared photon detector (QWIPs) are investigated. Ladar research is focused on FM/cu techniques that permit high-resolution but low frequency range readout. Research for uncooled IRFPAs is based on development and analysis of thin film ferroelectric materials and novel detector architectures with improved thermal isolation structures. Uncooled IRFPAs will also have significant civilian applications.

FY 1998 Accomplishments:

- 1093 Demonstrated improved quantum efficiency in QWIP detector array with coupled well structure.
- 435 Demonstrated dual color QWIP array.
- 674 Analyzed level impurities and dopants in II-VI semiconductor materials for advanced sensors.

Total 2202

FY 1999 Planned Program:

- 592 Demonstrate 1.5 *u*m quantum well modulator for ladar.
- Demonstrate advanced thin film ferroelectric structure for low cost uncooled, infrared focal plane arrays (IRFPA) which provide order of magnitude production, maintenance and cost benefits over current models.
 - Determine normal incidence performance of polytype based alignment detector structures.
- 5 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 1998

FY 2000 Planned Program:

- 2341 Demonstrate high power 1.5 um diode laser and quantum well modulator/mixer for ladar with 600 MHz bandwidth.
 - Design and fabricate low cost uncooled IR detector array.

Total 2341

Project A31B Page 64 of 74 Pages Exhibit R-2A (PE 0601102A)

	,	ARMY RDT&E BUDGET ITE	M JUSTIFICATION (R-2A Exhibit)	DATE Febru	ary 1999
BUDGET AC 1 - Basi		arch	PE NUMBER AND TITLE 0601102A Defense Researc	h Sciences	PROJECT A31B
FY 2001 P					
•	2421	Investigate material growth and device of a Investigate design for IRFPA to be utilized.	design for LWIR FPA operating above 100°K. zed for active and passive imaging.		
Total	2421				
Project A3	31B		Page 65 of 74 Pages	Exhibit R-2A (PE 060	1102A)

Item 2

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **B52C** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete B52C Mapping and Remote Sensing 2026 2284 2305 2342 2379 2785 3236 3328 Continuing Continuing

Mission Description and Justification: This project supports research in fundamental topographic sciences to improve the tactical commander's knowledge of the battlefield; to extract and attribute natural and man-made features from reconnaissance imagery in near-real time; to exploit terrain analysis and reasoning techniques, and to explore the potential of space technology to provide real-time terrain intelligence, command and control, and targeting support. The research provides the theoretical underpinnings for Program Element 0602784A, Project A855.

FY 1998 Accomplishments:

2026 - Developed terrain feature extraction protocols from integrated Multispectral/Hyperspectral/IFSAR imagery.

- Devised neural network image data classification capability.
- Investigated the generation of a vegetation/climate model to map interpolated and inferenced climate terrain inaction data.
- Defined the critical spatial interrelationships of terrain and threat behavior interrelationships.

Total 2026

FY 1999 Planned Program:

- 2224 Determine optimal combination of sensor information for generation of topographic data (elevation, feature, and imagery).
 - Evaluate geostatistical wavelet technique for performing image compression.
 - Upgrade climate atmosphere model parameters to enhance tactical decision aids.
 - Explore and prototype methods for automated data capture, characterizing and quantifying models and the dependent relationships across terrain, threat, and military activities.
- 60 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs

Total 2284

FY 2000 Planned Program:

- 2305 Investigate multivariate statistical analysis, multivariate interpolation, and enhancements for image analysis.
 - Investigate generating topographic data using a combination of sensor information.
 - Evaluate initial geostatistical models of climatic atmospheric parameters integrated with line-of-sight models for denied areas where limited or no data is available.
 - Evaluate models and their performance to characterize expected battlefield state against actual data sets from operational databases.

Total 2305

Project B52C Page 66 of 74 Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 PE NUMBER AND TITLE BUDGET ACTIVITY PROJECT 0601102A Defense Research Sciences 1 - Basic Research **B52C** FY 2001 Planned Program: 2342 - Investigate enhancement of neural net and subpixel methods of feature extraction. - Investigate hyperspectral imagery analysis/segmentation. - Devise model to predict precipitation frequency data in the absence of weather data in denied areas. - Investigate the potential to integrate empirical and inductive analysis systems. 2342 Total Exhibit R-2A (PE 0601102A) Project B52C Page 67 of 74 Pages

Item 2

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **B53A** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete B53A Battlefield Environment and Signature 3470 3146 3678 3804 3942 4614 4928 5143 Continuing Continuing

Mission Description and Justification: This project provides an in-depth understanding of the complex atmospheric boundary layer associated with high-resolution meteorology, the transport, dispersion, optical characteristics and detection of chemical and biological aerosols, and the propagation of full-spectrum electro-magnetic and acoustic energy. It impacts Army chemical and biological defense operations, electro-optic and acoustic sensors, smoke/obscurant deployments and target acquisition. This project supports Army Strategic Objectives, provides technology for the Integrated Meteorological System (IMETS) and supports Project Reliance under the Defense Technology Area by providing Tri-Service transport and dispersion research and development. This project is the leader in boundary layer meteorology over land and urban terrain research.

FY 1998 Accomplishments:

- 2470 Invo
 - Investigated rapid methods for the detection of potentially lethal, low concentrations of harmful bacteria and toxin aerosols; invented highly improved methods for measuring fluorescence of single aerosol particles.
 - -Tested and validated the boundary layer model of airflow over complex terrain and within and above vegetative canopies and built-up areas for Army tactical scales.
 - Developed horizontal transilient turbulence theory (an alternative method of describing the effects of turbulence, capable of handling the realistic case of multiscale effects in a single step, substantially reducing computation time), that includes surface layer effects.
 - Completed a prototype acoustic propagation model incorporating complex terrain that was incorporated into a decision aid, providing calculation of acoustic detection probability in realistic environments.
 - Developed theory for sound propagation through large-scale, anisotropic turbulence, including turbulence effects on acoustic target-finding arrays.
 - Developed theoretical and numerical models for sound fields generated by moving targets.
 - Incorporated horizontal radiative transfer techniques into the boundary layer illumination and radiative balance model that improves contrast calculations for target acquisition.
 - Completed an Ultra Violet (UV) and visible wavelength propagation model that includes multiple scattering effects.

Total 3470

FY 1999 Planned Program:

- 3146 Analyze atmospheric effects on acoustic imaging and coherence using a three-axis orthogonal microphone array.
 - Determine the effects of turbulent intermittency and partial saturation on acoustic target detection and bearing estimation.
 - Develop methods for approximate representation and decomposition of turbulence structure using wavelet and other analyses, and apply to acoustical scattering calculations.

Project B53A Page 68 of 74 Pages Exhibit R-2A (PE 0601102A)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit) BUDGET ACTIVITY 1 - Basic Research PE NUMBER AND TITLE 0601102A Defense Research Sciences PROJECT B53A

FY 1999 Planned Program: (continued)

- Complete a set of experiments and theory on the impact of polarization on image propagation in the real and battlefield atmosphere for target acquisition.
- Develop and test a coupled high-resolution meteorological transport and dispersion model.
- Test and validate a coupled 3-D surface boundary layer meteorological model.
- Improve rapid methods for the detection of potentially lethal low concentrations of harmful bacteria and toxin aerosols.
- Develop improved methods of trapping single aerosol particles.
- Evaluate converting the Battlescale Forecast Model (BFM) to a non-hydrostatic model for improvement of severe weather predictions.
- Develop an intermediate scale hydrostatic forecast model to provide BFM with an upgraded capability to depict and forecast mesoscale phenomena not seen in global scale model data.

Total 3146

FY 2000 Planned Program:

- Develop methods for discriminating between naturally occurring aerosols and manmade aerosols; develop improved methods of sorting individual aerosol particles.
 - Develop theory and numerical models of propagation of sound through inhomogeneous, anisotropic turbulence, including refraction and ground reflections.
 - Model and perform experiments on low-frequency acoustic propagation in forest canopies and littoral regions.
 - Complete theory and software linking 3-D atmospheric propagation and radiative transfer models to standard interfaces, such as the Total Atmosphere and Ocean Services (TAOS) server, for DoD simulations.
 - Couple 2-D surface layer wind model with full 3-D boundary layer meteorological model.
 - Couple canopy and urban flow technologies into transport and dispersion models.
 - Incorporate detailed Surface Energy Balance in Surface Layer Model.
 - Conduct stable boundary layer meteorological field experiment, CASES-99.
 - Develop new algorithms for depicting physical processes for better analysis and prediction of icing, low level clouds, and precipitation at time and spatial scales required for accurate quantitative depiction of target area atmospheric conditions.

Total 3678

FY 2001 Planned Program:

- 3804 Investigate and correct problems with transilient turbulence model.
 - Improve boundary layer model by incorporating stable atmospheric conditions.
 - Develop 3-D numerical models for acoustic propagation over complex (hilly and mountainous) terrain.
 - Model and perform experiments on high-frequency acoustic propagation in forest canopies and littoral regions.

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	ARN	Y RDT&E BUDGET ITEM JUSTIFIC	CATION (R-2A Exhibit)	February 1999
BUDGET ACTIVIT 1 - Basic R			PE NUMBER AND TITLE 0601102A Defense Research Science	PROJECT B53A
FY 2001 Plan	- Co turbi - De - Inv - De	am: (continued) mplete a 3-D atmospheric propagation and simulation stalence, clouds, aerosols, and smoke. velop experimental capability for hyperspectral or sensor estigate the use of multiple excitation wavelengths and velop new algorithms for depicting physical processes for all scales required for accurate, quantitative depiction of	or fusion research with applications for atmospheric prelastic scattering in characterizing aerosol particles. or better analysis and prediction of turbulence, wind s	opagation.
Total 3	804			
Project B53A		Page	70 of 74 Pages Exhib	t R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **B74A** FY1998 FY 1999 FY 2000 FY 2001 FY 2002 FY 2003 FY2004 FY2005 **Total Cost** Cost to COST (In Thousands) Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete B74A Human Engineering 2453 2248 2607 2685 2766 3175 3446 3586 Continuing Continuing

<u>Mission Description and Justification</u>: This project supports research on soldier performance, including the areas of visual, auditory, cognitive, and stress-related performance. The objective is to identify, describe and manage underlying human-system interface factors critical to the design of Army weapon systems. The work in this program is consistent with the Army Science and Technology Master Plan (ASTMP), and the Army Strategic Research Objectives (SROs).

FY 1998 Accomplishments:

- 2452 Com
 - Completed report on the effects of spatial separation on the detection and localization of sound signals presented in noise. Continued to explore the effects of practice and learning on human auditory performance.
 - Continued investigation of hyperstereopsis and its effect on visual perception and depth compression for night vision goggle resolution and field of view design guidelines.
 - Conducted a helmet mounted display field study examining design tradeoffs in information display format and the relative impact on soldier cross-country navigation performance.
 - Continued verification and validation of the noise hazard model with hearing loss data. Delivered beta site versions to NATO Research Study Group (RSG), Medical R&D command, and Society of Automotive Engineers (SAE) Airbag Committee. Conducted field experiment with the previously developed auditory hazard meter to determine user applications.
 - Published report on the effects of stress on voice recognition system efficacy. Conducted studies on the relationship between stress and complex cognitive functioning.
 - Published report on quantification of attentional field of view (FOV) under various divided attention conditions as a predictive measure of driving ability and navigation.

Total 2453

FY 1999 Planned Program:

- 2229 Complete data collection efforts on human auditory processes in detecting sound in various environments and estimating the distance from the sound source.
 - Publish results of previous studies examining the interaction effects of field-of-view, ocular configuration, and image resolution on task performance using night vision devices in tactical settings; develop draft set of operational metrics for measuring depth perception and visual attention.
 - Publish results of previous helmet-mounted display studies. Develop a model that evaluates changes in soldier performance and workload as a function of changes in display design.

Project B74A Pages Exhibit R-2A (PE 0601102A)

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 1 - Basic Research 0601102A Defense Research Sciences **B74A** - Develop random incidence corrector and calibration procedures for a "general damage" auditory model. Submit impulse noise standards for Committee on Hearing and Bioacoustics (CHABA) review. FY 1999 Planned Program: (continued) - Refine previously developed psychological stress measures and investigate the effects of cognitive skill performance. - Develop a methodology for studying the role of visual attention in target acquisition. 19 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs 2248 Total FY 2000 Planned Program: 2607 - Publish results of previous studies on human auditory perception. - Conduct laboratory study to examine the effects of various colors on task performance using night vision devices. - Develop advanced windows based version of auditory hazard model with active middle ear muscles and azimuthal correction capabilities. - Conduct a field experiment to measure the effects of information availability (timing and frequency) and information accessibility on situational awareness and decision making ability using helmet mounted displays (HMDs). - Investigate the effects of specific battlefield stressors on situational awareness and decision making under conditions of uncertainty. Develop a draft set of operational stress measures. - Examine effects of attentional set and processes of pattern recognition and form perception in terms of soldier target acquisition performance. 2607 Total FY 2001 Planned Program: - Investigate the effect of acoustic source motion on human auditory perception. - Refine previously developed operational metrics for measuring depth perception and visual perception to incorporate the effects of color on size and depth cues. - Develop hearing protection algorithms and incorporate into auditory hazard model. - Measure and compare the individual and combined effects of both audio cues and visual presentation of information on task performance using HMDs. - Refine and validate previously developed operational stress measures. - Publish report of findings on the effects of pattern recognition and form perception on target acquisition performance. Begin to examine the effects of target motion on target acquisition and identification. Total 2685

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Project B74A

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)									February 1999			
BUDGET ACTIVITY 1 - Basic Research					PE NUMBER AND TITLE 0601102A Defense Research Sciences					PROJECT B74F		
CO	ST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost	
B74F Personnel Perform	ance and Training	2425	2146	270	8 2818	2862	2899	2944	3033	Continuing	Continuir	
Congressional plus-up, attrition, leadership, ne FY 1998 Accomplishm • 2425 Total 2425 FY 1999 Planned Programmed Pro	Developed a set of technique. Provided a blueprint and personnel performance and trepresent the Developed a model of the efficient completed analysis of the efficient completed research on effect gram:	D Defense Hommand climes for improve spective on aining researches of shareffects of the cts of individual control of the cts of ind	lealth Progra nate, and eff ving the rete key Army A rch stay ahe ed goals and post-Cold W lual tempera	ects of incomment of incomment of incomment on possible and incomment	y, to this PE/Preased person generalizabili (AAN) human e changes in f odels on team y situation and erformance ar	Project, provinel tempo. Ty of proceding and organic force structure performance of conditions and learning.	ding funds ural skills ne zational issu re and missi e and the eff	for short ter eeded in digi es through r on requirem fectiveness of	m work on to attized environ national work ents. of leaders.	opics includi	ing	
- - - -	Determine the role of transfer Develop a model to maximize Fully develop a technique to Continue research on the inf Complete research on indivi- Small Business Innovation I	ze training en better under fluence of ge dual differer	ffectiveness rstand the at ender/race/et nces in spatia	and efficientitudes of in the characteristics and the	ency for select nner-city you sity on cohesi- nd how those	th toward And on, morale, a differences	my service. and readines affect an ind	ss.			routes.	

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Project B74F

DATE **ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)** February 1999 BUDGET ACTIVITY PE NUMBER AND TITLE **PROJECT** 0601102A Defense Research Sciences 1 - Basic Research **B74F** FY 2000 Planned Program: 2708 - Develop models for effective leadership of small, AAN-type units to maximize leader and unit resiliency to adversity. - Analyze Army culture and types of training material to help commanders use that culture effectively. - Complete research on analysis of tacit knowledge and how it contributes to effective leadership. - Model the results of a long-term analysis on the durability of tank gunnery skills in the absence of practice. Total 2708 FY 2001 Planned Program: 2818 - Complete a model on the effects of electronic communication on the development of trust between subordinates and leaders. - Evaluate the use of latent semantic analysis to assess an individual's knowledge structure and to aid in the automatic analysis of free-range text descriptions. - Continue research on cohesion, morale, and performance effectiveness, particularly as affected by different types of missions and gender issues. - Continue research on the learning, durability, and transferability of trained skills required for the digital environments. 2818 Total Exhibit R-2A (PE 0601102A) Project B74F Page 74 of 74 Pages